POWER

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Oil and Gas Power Week

LAST WEEK from Orono, Maine, to Portland, Oregon; from Toronto, Ontario, to New Orleans, engineers discussed, and the public heard of, the importance and possibilities of gas and oil as sources of power.

I do not know how much more gas and oil or how many more internal-combustion engines will be used on account of it, but it seems as if the concentration of engineering thought upon the subject in something like eighty meetings, some of several days' duration, contributed to by the best authorities and the most successful practitioners, should awaken interest, stimulate thought and accelerate the progress of the art.

It is only fifty-one years since Otto produced the engine that used the cycle that bears his name and only thirty-five years since Diesel brought out the heavy-oil engine compressing above the ignition temperature.

The visions of the late nineties, great gas-engine stations driven by producer gas, did not fructify, and even where blast-furnace gas is available, it is often used to make steam with which to run the simpler and more powerful turbine.

But the oil engine in both smaller and larger capacities is finding new applications and wider fields of usefulness.

It is in the type that uses the lighter fuels that the internal-combustion engine has found its widest application. It has made possible the automobile, the motor boat and the airplane, and had perhaps the greatest effect of any modern contribution of the engineer in widening the radius of the ordinary life, conquering time and distance and making the remote accessible.

It is difficult to visualize the retrogression that would come with a failure of the fuel supply for this type of motor.

It took Nature a million years to make a pint of gasoline. We use it in a few minutes. And we do not know that she is making any more.

F. R. Low

Laundry Power Plant Increases Capacity 50 per Cent with 10 per Cent Less Steam

A PRODUCTION increase of 50 per cent and a coal saving exceeding 10 per cent are the results credited to the installation of a sealed and balanced steam supply and drainage system in the new plant of the American Linen Supply Co. in Chicago. In a number of industrial cities this company maintains a general linen supply service, which requires a laundry of some magnitude with demands for large quantities of hot and cold water, a considerable amount of electrical energy for power and lighting and compressed air for the pressrooms.

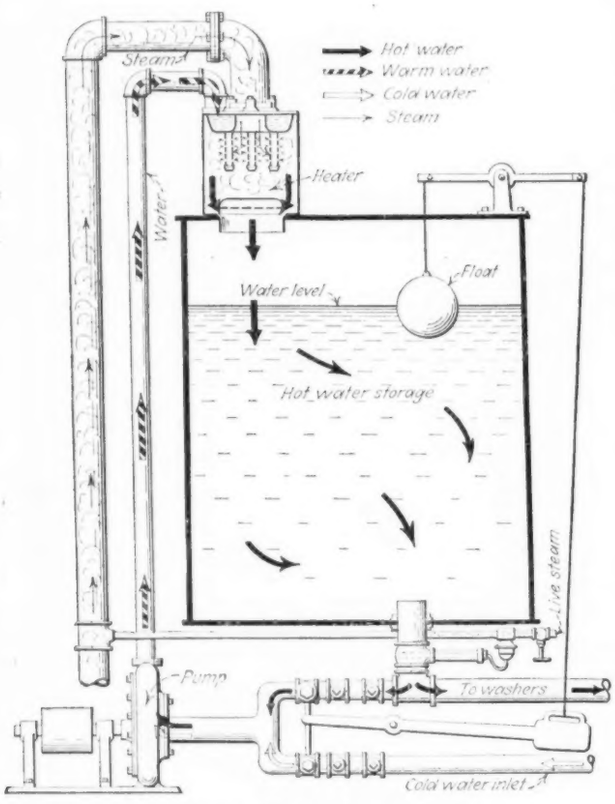


Fig. 1—Hot water system

In all plants of the company the demand for exhaust steam to heat the water exceeds that available from the power load, so that live steam must also be used. Conditions are thus favorable for a generating plant.

During the summer of 1926 an attractive four-story building, with basement and sub-basement, was completed for the Chicago branch and equipped with a modern power plant furnished with the necessary auxiliaries and instruments to insure efficient operation. Two water-tube boilers of 3,500 sq.ft. each, served by natural-draft chain grates, supply steam at 125 lb. gage pressure. Headroom of 8 ft. gives a sizable furnace for the efficient burning of Illinois coal. The fuel is stored in bins aggregating 200 tons capacity, from which gravity delivery is made to an industrial car suitable for hand shoveling of the coal into the stoker hoppers. Steam-jet conveyors remove the ashes.

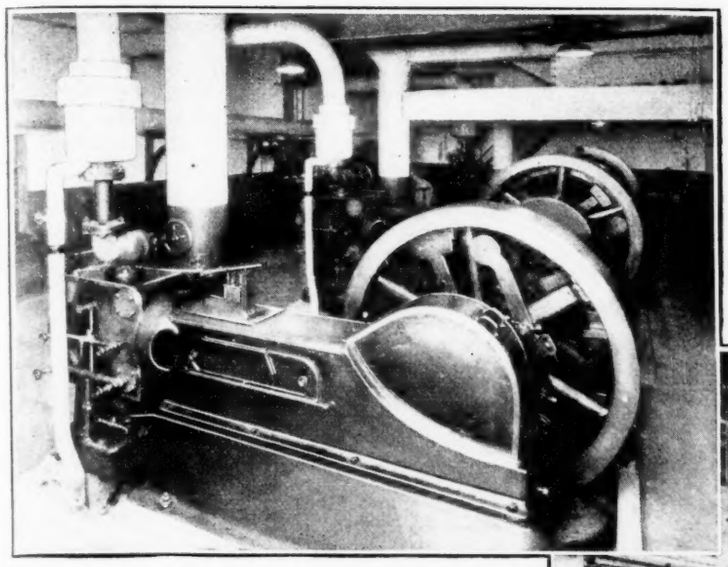
To handle flexibly a 220-volt power and 110-volt lighting direct-current load running up to and at times above 175 kw., three generating units with direct four-valve-engine drive were provided, two from the old plant of 75 and 125 kw. capacity and a new unit rated at 150 kw. With a steam rate of 22 lb. per i.hp.-hr. as compared to 25 lb. for the smaller engines, the new unit is operated so long as the load approximates its most efficient point of operation. There are periods when an additional machine is required, and upon occasion the two smaller units may relieve the larger one. With the demand for exhaust steam exceeding the supply, the flexibility and reserve capacity provided are of greater importance than the steam rate, particularly as plans have been made to enlarge the laundry at a future date. A direct-current supply for nights and holidays is provided by a small motor-generator set drawing from utility service.

All Water Is Softened

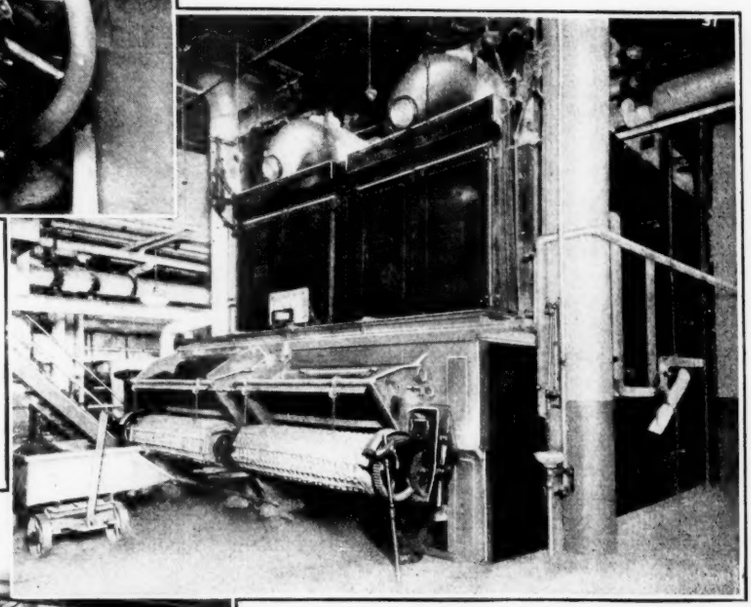
For the entire plant the water demand totals some 200,000 gal. per day. To prevent scale and rust deposits and to save soap, all this water is softened. One-half of the supply is heated and the rest is used cold mainly for rinsing purposes. Two 35,000-gal. tanks on the roof provide storage capacity and sufficient head to feed by gravity, the supply being maintained by two motor-driven 400-g.p.m. centrifugal pumps.

In the hot-water system a number of conditions peculiar to laundries had to be considered. For example, the draw is intermittent, large volumes being required at different times, especially during rinsing periods. The exhaust steam naturally comes in a steady flow and must be absorbed and stored against the heavy intermittent demand from the washroom. To prevent the excessive corrosion to be anticipated from hot water, deaëration is desirable.

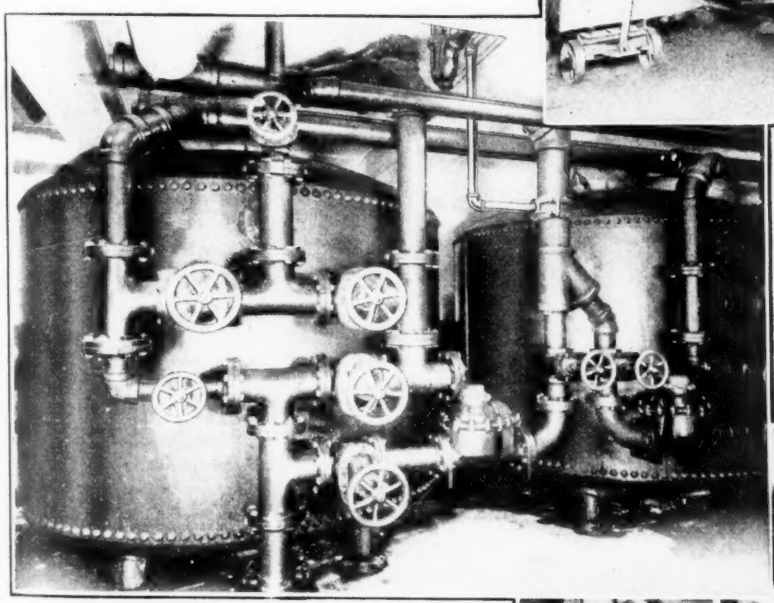
In the plant under consideration these conditions are met by the special hot-water system shown in Fig. 1. It will be seen that the water from storage is recirculated, being mixed with a definite percentage of cold water, as determined by the position of the float, and discharged into the heater head through a large number of small openings, so that the water may come into intimate contact with the exhaust steam. When the storage space is full, the cold water is shut off automatically, but the recirculation of the storage water continues to absorb the exhaust steam as before. Should the water drop below the desired temperature, a thermostat in the outlet from storage automatically turns live steam into the exhaust main.



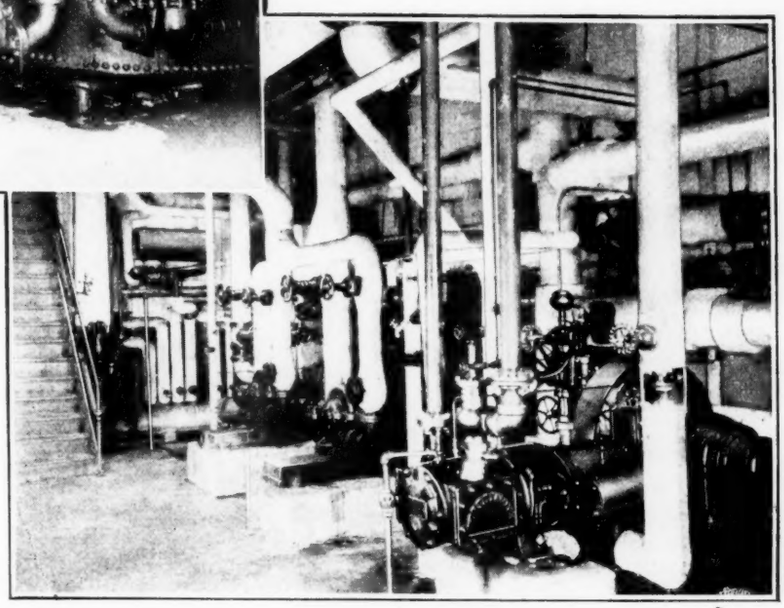
The engine room contains three generating units



A neat looking boiler room that any management would be proud of



Water softening is an important feature in this plant



Pumps and air compressor. The former supply service water to the roof tanks

With the exhaust-steam supply available, the water in this heater is maintained at a temperature in the vicinity of 130 deg. F. From this source boiler makeup water is drawn, being passed through a closed booster heater in the boiler room and admitted to return traps over the boilers under the control of feed-water regulators. The laundry supply of hot water is raised in temperature from 130 to 180 deg. in the washing machines by the use of live steam.

Condensation from all the seventy-odd laundry machines on the three operating floors is drained by gravity to a high-pressure receiving tank on the boiler-room floor. The drips from the several high-pressure steam distribution points, as well as those from the engine separator drains, are combined by gravity into one common drainage point, and the condensation delivered to this same receiver by a non-return trap. The single-pipe heating system of the building using exhaust steam at 2 lb. pressure is drained by the same gravity method and the condensation delivered to the receiver, previously mentioned by a direct return trap.

In other words, all condensation and drips in the plant are returned to a common point and by the average pressure there raised to direct return traps, one for each boiler, placed at an elevation of 6 ft. above the water level. Thus the condensation from all sources about the plant is collected by gravity without the usual number of small individual traps and supplied through a special return system to the boilers at a temperature approximating 320 deg. F. in this particular plant. The makeup is introduced separately by other traps, as previously outlined.

This water temperature is 120 deg. higher than would be permissible with a vented receiver and a pump feed to the boiler. Makeup water at a lower temperature reduces the final temperature of the feed to a point still giving an excess temperature of about 100 deg. over that usually obtainable. On the basis of 1 per cent saving in fuel for every 10 deg. F. rise in feed-water temperature, the saving in coal should approximate 10 per cent.

Capacity of Plant Greatly Increased

Additional savings are effected in lubrication, packing and maintenance costs, but an item of greater importance is the increase in capacity of the laundry machinery. By carefully balancing the sealed system and draining the steam lines before they reach the individual machines, rapid circulation of the steam through the equipment is effected and there is no collection of condensation to lower temperatures and reduce capacity.

To obtain a comparison between the sealed drainage system and a system employing individual traps at each machine, and a vented receiver, tests were made at the new and old plants in Chicago on the same make and size of flat ironers operating under the same differential in steam pressure. In order that the work might have the same moisture content, a load of bib aprons was divided between the two plants. At the new laundry the aprons dried at the rate of 35 ft. per min., and at the old plant the rate was 22 ft. per min., which means an increase in capacity of nearly 60 per cent in the item of drying. In general, the efficiency of presses, tumblers and other equipment was improved by nearly the same ratio, so that, roughly, the general claim of 50 per cent increase in production may be accepted and attributed to rapid circulation of the steam and improved drainage.

Protection of Electric Motors

A common source of trouble on electric motors is the lack of proper protection. In some cases it may be desirable to protect the driven machine as well as the motor. Means to disconnect the motor from the line automatically in case of overload will, under certain conditions, protect the driven machine from injury.

On electric elevators, hoists and such machines some other means must be provided, particularly if these are of the drum type. If the car or counterweights of a drum-type elevator are pulled into the overhead work, serious damage may be done to the machine without tripping the overload device on the motor. In all elevator applications means are provided to stop the car at the terminal landings and also to protect the equipment under various other conditions by incorporating in the control means for automatically disconnecting the motor from the line.

In general there is more danger of the motor's being injured by overloading than there is that the machine the motor is driving will be damaged. Overload protection can be obtained in various ways, and each has its advantages and disadvantages. The inclosed type of fuse is a common overload protection, and for many classes of installations it has much to recommend its use. It is much lower in first cost than any other type of protection, and where overloads seldom occur, it is very satisfactory. If there are frequent overloads that cause the fuses to blow, the time delays and cost of replacements make this type of protection expensive.

Another objection to the ordinary type of fuse is that it has a very limited time element in opening. Furthermore, this time element, such as it is, cannot be adjusted. Fuses, like some of the other types of protective devices, are subject to abuse. Where they give trouble by frequently opening the circuit, the tendency is to use oversize fuses rather than to find the cause of the overload.

Circuit breakers with some type of timing element or overload relays combined with contactor switches are used extensively. These are much higher in first cost than fuses obtainable with adjustable time elements that are fairly accurate in calibration. They are low in maintenance and, when tripped, are generally immediately ready for service again. This is an important feature where there are frequent circuit interruptions due to overloads. Of the different types of overload relays, the thermal is coming into wide use.

The ideal relay, so far as the motor is concerned, would be one with the same thermal characteristics as the motor. In other words, it should possess characteristics that will cause the motor to be disconnected when its temperature reaches a point where there is danger of injuring the insulation of the winding. In this respect the thermal-type relay offers advantages over the other types.

On alternating-current motors, protection should be provided against single-phase and reverse-phase operation. These two protections are generally combined in one and in some cases with overload protection.

The Capacity and Efficiency of a centrifugal pump falls off rapidly as the pressure head on the pump suction is decreased below the suction pressure for which the pump is designed. Therefore, before ordering a pump, the suction head as well as the total pump head should be determined as accurately as possible.

H. J. Macintire Discusses

Fashionable Styles in Ammonia Compressors

A DECADE ago it was thought that the ammonia compressor was nearly, if not quite, perfected and that little or no progress could be expected in the design from that time. However, this is not the case, and the compressor has been steadily improved in detailed design, in the extended use of stage compression, in compression with two suction pressures, in lubrication and in increasing the rotative speed.

The work of compression is now quite definitely known, inasmuch as tests have shown that the indicated horsepower of compression is nearly that obtained from the consideration of the work during an adiabatic compression. The division of opinion is not so marked as formerly with regard to the vertical single-acting open-frame type as compared with the horizontal double-acting compressor.

Other Factors Besides Power Consumption

Indeed, other factors besides the horsepower per ton of refrigeration are entering into the choice of the kind of compressor. The lack of headroom, combined with the objection on the part of the operating engineer to the necessity of continually climbing up the steps in order to reach the ammonia cylinders, is responsible for the decided decrease in the popularity of this particular form of compressor. In Great Britain the horizontal double-acting compressor, up to the last few years, had been practically unknown, but more recently attempts have been made to popularize it. The usual design of British compressor is that similar to Fig. 1, which is a four-cylinder, single-acting, vertical compressor of medium speed using a forced-feed lubrication.

American engineers will no doubt be interested in the frame design, for it is unusual to cast cylinders other than en bloc. Just how the British construction affects the stability of the machine cannot be stated. On the other hand, dismantling must be easy with the individual cylinder design.

In the United States the twin-vertical, single-acting, inclosed type and the horizontal double-acting compressors are the ones generally used. The outstanding change in the design has been in straightening and increasing the size of the gas ports, in the elimination of the old Linde type of poppet valve and in the substitution of the plate, the inertia and the ribbon valve. Until the last few years it could be said that the mechanically operated valve for refrigerating machines was unknown. Now, apparently, one British manufacturer has been successful in adapting the sleeve valve to refrigeration, which gives a large opening and a tight valve, as shown in Fig. 2. These machines are built up to 400 tons.

The tendency for increasing the speed, stimulated by a desire to reduce the cost of the motor and to direct-connect the motor to the compressor, has forced developments in cylinder lubrication. With the horizontal double-acting compressor the problem is solved by the use of the usual gravity tank, with sight feed, for the lubrication of the outside bearings and by the use of forced feed for the cylinder. The crosshead pin is lubricated by means of a drilled hole from the crankpin brasses. In the vertical single-acting inclosed compressor an oil pump distributes the oil through a drilled crankshaft and a drilled connecting rod. The use of the splash system is not satisfactory where high rotative speeds are employed. The important point is to have a positive feed of filtered oil to each and every bearing or rubbing surface.

Compound Compression an Old Idea

Compound compression for ammonia was introduced in the early eighties, but it was not a success. During the last ten years it has been developed until at the present time it is considered standard practice in certain cases, especially where the suction pressure is 10 lb. gage or lower and the condenser pressure is 175 lb. or higher. The gain by the use of stage instead of simple compression is principally in the decreased power requirements per ton of refrigeration and in the increased capacity due to the much greater volumetric efficiency. In the case of extreme operating conditions there is also a much reduced temperature of discharge due to the smaller ratio of compression per cylinder in the case of stage as compared with simple compression.

There are several different cycles of operation, but one of the desirable methods is to use an accumulator between the stages, whereby the gas evolved in the process of the first expansion valve, some 7 to 10 per cent, is permitted to pass directly into the high-pressure cylinder and the discharge gas from the low-pressure

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cylinder is cooled with water before entering the high-pressure cylinder. The weight of the gas handled in the high-pressure cylinder will therefore be somewhat greater than in the low-pressure cylinder.

Liquid injection into the cylinder is not used in modern compressors. Liquid injection or wet compression, has always been a mistake, as it cannot be controlled readily and the underlying principle is wrong. Liquid should be kept out of the cylinder of a reciprocating machine.

Dual Compression Operation

One method of operation that has not been sufficiently emphasized is that of dual compression. A number of plants have need of several evaporating temperatures of the liquid. In other words, two suction pressures frequently can be carried to better advantage. Because for economical operation the general rule is to have as high a suction pressure as possible and still obtain the necessary temperature.

For example, should zero deg. F. be desired, as well as a temperature of 20 to 30 deg. F. it would be necessary in the usual installation to operate with a suction pressure of about 10 lb. gage for the entire load, whereas with dual compression it would be necessary to have a piston displacement to carry the zero deg. F. load only. The higher suction pressure load would be taken care of through permitting the gas from these coils to enter the cylinder through piston overrided ports in the cylinder which register with the pipe-line connection to the evaporating coils carrying the higher pressure. If the plant is large enough, several compressors would be provided so that each would have its own load and operating pressures.

In the dual-compression system there is a small increase in economy, in addition to the decrease in the friction horsepower due to having one instead of two compressors, but the gain is only some 20 per cent in special cases. The most successful application of this principle is in the case of carbon-dioxide refrigeration, where the liquid refrigerant is cooled partly before it reaches the expansion valve and the gas generated by the cooling, which takes place at a higher pressure than that of the evaporating coils, enters the ports of the compressor. Such a device will probably become common practice in carbonic refrigeration where high condensing and low evaporating pressures are carried.

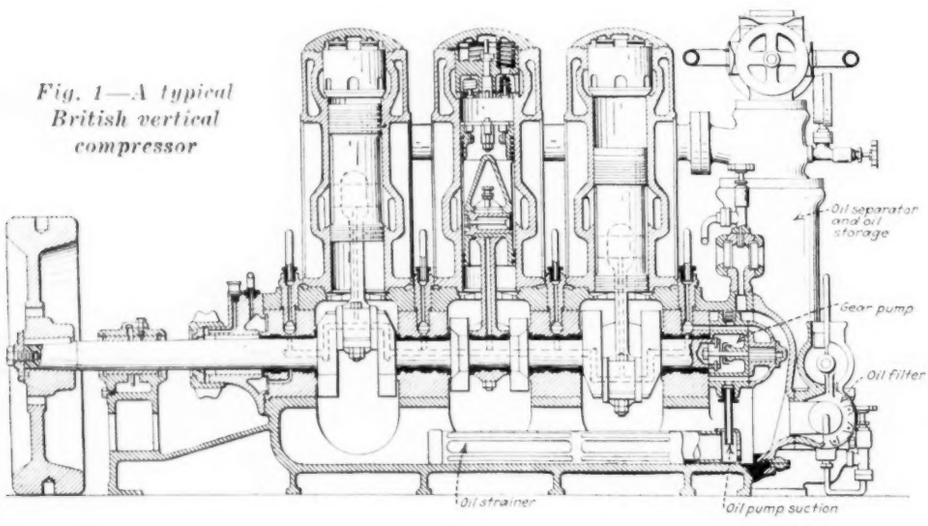


Fig. 1—A typical British vertical compressor

The tendency of the times is to increase the rotative speeds of refrigerating compressors. Speeds of from 200 to 600 r.p.m. are usual, and in the case of the inclosed type of vertical compressors the latest designs are rated at about twice the tonnage given the same size of compressor some years ago, although the sales price has not changed appreciably per ton of refrigeration. With the change there have appeared considerable difficulties. One of the earliest of these was the overheating of the cylinder, resulting in a seizure of the piston. In addition, with higher speeds the design of the individual details must be very carefully worked out, and provision must be made for low bearing pressures, low working stresses, hardening of parts and especially a positive system of lubrication. The materials of construction must be of the best available, and where castings are used they must be aged, and all the cylinder must be heat-treated to a greater or lesser degree. The machine work must be excellent and, even now, the cylinders are frequently lapped out where formerly they were finished with little better than a roughing cut. With slow speeds the compressor would pass inspection with an amount of out-of-line of the crankshaft with regard to the line of the cylinder that would not be tolerated at the present time.

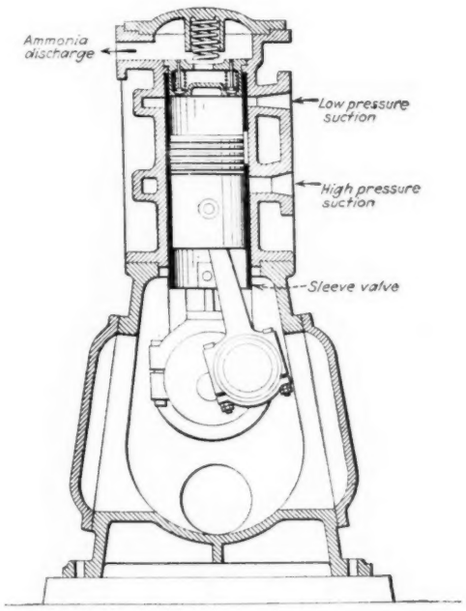


Fig. 2—British sleeve-valve compressor

To a large extent the change of rotative speeds has resulted from a desire to reduce the size of the compressor, but principally from a wish to use a direct-connected synchronous motor. In the inclosed type of compressor it is becoming the practice to have a flywheel type of synchronous motor.

The design and construction of

Pressure Vessels—I

Fundamental Principles—Cast and Riveted Construction

By LEWIS J. SFORZINI

THIS outline of pressure-vessel engineering, in two installments, will meet the needs of those who select and use power-plant equipment and desire to familiarize themselves with the best modern practice in the design and construction of pressure vessels. Recognizing the importance of welded and seamless construction and other modern developments, Mr. Sforzini sees also a field for the standard cast and riveted designs, which are covered in the present article along with those fundamentals that apply to all types of construction. The second and concluding installment will cover the latest developments in seamless and welded pressure vessels.

PRESSURE vessels are classified as to use into two broad classes—fired and unfired. The first includes all steam boilers and parts, such as economizers, superheaters, reheaters, etc., exposed directly to the products of combustion. The second includes all other pressure vessels.

There are nine distinct processes that may be employed in the fashioning of pressure vessels made of iron or steel. These may be classified and subdivided as follows:

1. Machining from the solid.
2. Cold drawing or working.
3. Brazing.
4. Casting { (a) Cast iron. (b) Semi-steel. (c) Steel.
5. Riveting.
6. Forging.
7. Hot drawing or rolling { (a) Rolling from billets. (b) Drawing from disks.
8. Welding { (a) From plates entirely heated { i Butt. (b) From plates locally heated. { ii Lap.
9. Fusion welding ..... { (a) Gas. (b) Electric arc.

Each of these processes may be combined with one or more of the others to give the complete vessel.

The first three processes are employed only to a limited extent for complete pressure vessels used in the power plant and then only in the smaller sizes. These will not be discussed further. Of the other processes, until quite recently only casting and riveting were in extensive use. Today, forging, hot-working, welding and fusion welding have also assumed importance for certain classes of work, and their field is gradually broadening.

Iron castings are used for small, low-pressure heating boilers, heaters, steam and oil separators, pump and air receivers, certain types of ammonia apparatus, steam traps, steam condensers, air intercoolers and aftercoolers, certain piping which may be considered as pressure vessels, and as part of other vessels. For all this class of work cast iron has proved satisfactory when kept within the proper limitations. The limitations are fixed by a multitude of factors, the most common of which are pressure, temperature, size, weight and cost.

Fig. 1 depicts a non-ribbed cylindrical cast-iron container which forms the shell of a coil-and-shell brine cooler. A large number of such pressure vessels have given excellent service over a long period of years.

This, or any cylindrical vessel for that matter, is figured for bursting along a longitudinal plane by the common tank formula,

$$f = \frac{pd_1}{2t} \text{ or } p = \frac{2tf}{d_1};$$

where

f = Tensile stress, in pounds per square inch;
d_1 = Inside diameter of the vessel, in inches;
p = Internal pressure, in pounds per square inch;
t = Thickness of shell in inches.

This formula is strictly true only for shells of infinitely small thickness, but where ratio of shell thickness to shell diameter is under 5 per cent, it introduces but a small error. For ratios over 5 per cent the outside diameter d_2 (giving Barlow's formula) should be substituted in the foregoing formula for safety. The theoretically correct formula for all shells with closed ends is that of Clavarino, as follows:

$$f = \frac{13d_2^2 + 4d_1^2}{10(d_2^2 - d_1^2)}\, p; \text{ or } p = \frac{10(d_2^2 - d_1^2)}{13d_2^2 + 4d_1^2}\, f.$$

As an example of the use of these formulas we will apply them to the tank of Fig. 1, wherein we will assume a figure of 3,000 lb. per sq.in. for f, which in this case is working instead of bursting stress.

By the simple tank formula:

$$p = \frac{2 \times 1.75 \times 3{,}000}{34} = 309 \text{ lb. per sq.in.}$$

By Barlow's formula:

$$p = \frac{2 \times 1.75 \times 3{,}000}{37.5} = 280 \text{ lb. per sq.in.}$$

By Clavarino's formula:

$$p = \frac{10(37.5^2 - 34^2)}{13 \times 37.5^2 + 4 \times 34^2} \times 3{,}000 = 327 \text{ lb. per sq.in.}$$

This shows that for the ratio of shell thickness to shell diameter used, the tank formula permits a working

pressure slightly under Clavarino's, and that Barlow's restricts the working pressure an appreciable amount.

After a certain greater thickness ratio is reached, the tank formula will permit a greater working pressure than Clavarino's, and hence is unsafe. Barlow's formula, on the other hand, permits safe working pressures

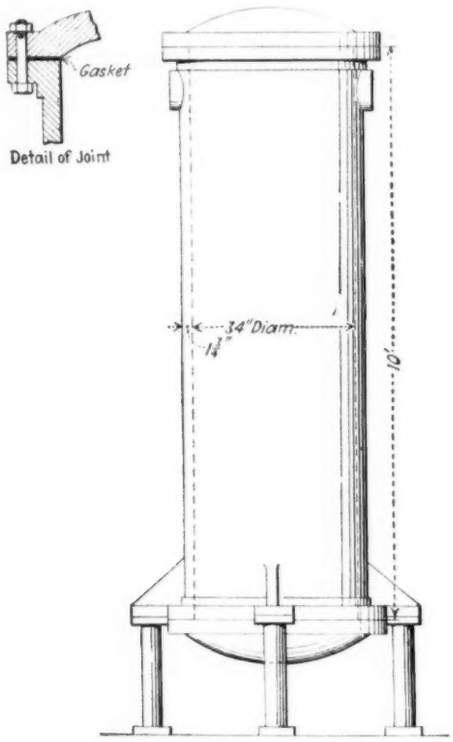


Fig. 1—Typical cast-iron cylindrical vessel

below that of Clavarino's for any practical thickness ratios.

Clavarino's formula has the disadvantage that it involves too tedious calculations, so that for ordinary work the other two formulas are used and give approximately correct results within the limits indicated.

All the foregoing formulas indicate that if the thickness is sufficient, a cast-iron vessel will withstand even extremely high pressures. But for extremely high pressures the cost due to the weight of metal required is much greater than the cost of vessels using other processes and materials.

To reduce the weight of a casting and still permit it to resist pressure, ribbed construction is very common with cast iron. Even with ribs the pressure on a cast-iron flat surface cannot be high, and for this reason cast-iron flat surfaces in pressure vessels of large size are used only for low-pressure steam water heaters, steam condensers and similar work.

The ultimate strength, and hence the safe tensile strength of cast iron, as well as the elastic limit, vary considerably. For gray-iron castings the ultimate strength may range from 15,000 lb. per sq.in. in the lowest grade to 25,000 lb. in high-grade cast iron, such as is used in valves and fittings. A safety factor of at least six should be used in figuring cast-iron pressure vessels. Cast iron possesses the favorable property of resisting corrosion even when it acts as a container for hot water of high oxygen content; this is one of the reasons why its use for heaters and work of that nature continues.

"Semi-steel," so called, may be considered as a superior grade of cast iron and is subject to the same discussion. The ultimate tensile strength and safe working stress are equal to about one and one-half times those of the best grade of gray iron.

Steel castings are made in comparatively small sizes, and their use is confined to pipe fittings, valves, boiler parts, steam traps and separators, flanges, nozzles and other small pressure vessels. Cast steel possesses advantages over cast iron in having a higher tensile strength and elastic limit, in not being subject to breakage due to sharp blows, and above all in not deteriorating when subjected to high temperatures such as are encountered in superheated steam service.

For cylindrical vessels the formulas already given apply to steel castings, except that the working tensile strength is higher and a lower factor of safety, usually 5, may be used. The ultimate strength of cast steel may vary from 30,000 lb. per sq.in. for a medium grade, to 65,000 lb. for a high grade of casting.

Riveting is the process most extensively used for making large-sized pressure vessels, although for certain classes of work it is losing ground to some of the other processes. Rivets may be driven cold or hot, although hot driving is used practically to the exclusion of cold driving in pressure work with ferrous metal. Pressure driving of rivets gives a more satisfactory result than driving by blows.

When the parts of pressure vessels are joined with rivets, the result is a job that is structurally safe, but

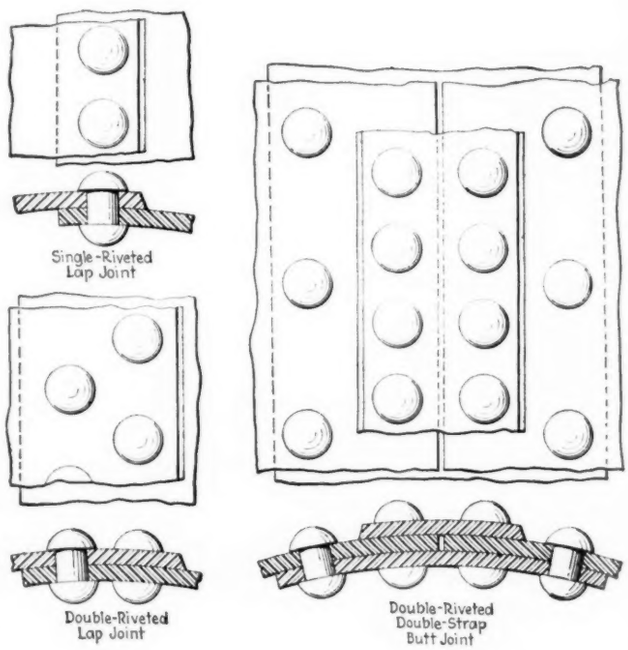


Fig. 2—Common types of riveted joints

usually not tight or leakproof. To make a riveted joint tight it is necessary before riveting to bevel the edges of at least one of the joined members. After riveting this edge must be forced hard against the adjacent member by the process known as calking. A riveted joint is never as strong as the original plate, although with certain elaborate designs of joint it may be made 94 per cent as strong.

Fig. 2 illustrates three of the most common of the riveted joints used for longitudinal joints on cylindrical

vessels. The single-riveted lap joint is the cheapest and simplest to make up. With proper joint design the efficiency can be made from about 55 to 60 per cent.

The efficiency of a riveted joint is the ratio of the weakest possible method of joint failure to the strength of the original plate expressed as a percentage. Any riveted joint may fail owing to any of three simple stresses or by any combination of these three stresses. The three simplest methods of failure are by tearing the plate in the net section (or "ligament") between rivet holes, by shearing the rivets and by crushing the plate ahead of the rivets. These simple methods of failure may occur in either lap- or butt-riveted joints. The combination method of failure is possible only in the butt joints.

A properly designed double-riveted lap joint has an efficiency of about 69 per cent for plate thickness of $\frac{1}{4}$ in. to $\frac{1}{2}$ in. The lap joint may sometimes be triple riveted, although this design is not shown in Fig. 2.

The lap-riveted designs create high eccentric stresses and should not be used on longitudinal joints for high pressures and large diameters combined. The limit of pressure and diameter is usually fixed by state or local law, insurance regulation or the code governing at the place of installation.

Butt joints create but small eccentric stresses. A properly designed double-riveted, double-strap butt joint has an efficiency of about 82 per cent for ordinary plate thickness.

Two other common joints not shown are as follows: The triple-riveted double-strap butt joint with efficiencies ranging from 87½ per cent in ¼-in. plate down to 83 per cent in 1-in. plate, if properly designed; the quadruple-riveted double-strap butt joint, having efficiencies ranging from 87 per cent to 94 per cent in plate ¾ in. to 1¼ in. thick, depending on the type of joint. It will be observed that the higher the joint efficiency required, the more elaborate the joint becomes.

The safe working pressure on a longitudinal joint may be computed, using the same symbols as before, from the following formulas:

$$p = \frac{2ft}{d_i} \times \text{Efficiency; for ratios of shell thickness to diameter less than 5 per cent;}$$

$$p = \frac{2ft}{d_o} \times \text{Efficiency; for ratios of shell thickness over 5 per cent.}$$

The circumferential girth or head seams may be proved theoretically to be subjected to only half the stress of the longitudinal seams, so that the efficiency need be but one-half that of the longitudinal joint in the same shell. Single- or double-riveted lap joints will give this efficiency for any practical plate thickness.

Steel plates may be obtained in twelve or more distinct grades, the most common of which for pressure vessels are: "tank," "firebox," "flange" and "welding." Flange and firebox are high-grade open-hearth steel plates with certain specified chemical and physical limitations, including an ultimate tensile-strength range of from 55,000 lb. to 65,000 lb. per sq.in.

Welding plate is a special grade of open-hearth steel suitable for forge and fusion welding, although not confined to this work. It has certain specified chemical and physical limitations, including a minimum tensile strength of 45,000 lb. per sq.in.

Tank plate may be bessemer or open-hearth steel and has no very definite chemical or physical limitations. Tank steel should not be used in high-pressure vessels.

The rules and specifications covering pressure vessels, both fired and unfired, contained in the Boiler Code of the A.S.M.E. are generally used and approved by all engineers as far as riveted construction is concerned. The Code is subdivided into two parts, one pertaining to boilers and the other to unfired pressure vessels.

The part of the code pertaining to riveted vessels was evolved after riveted construction had undergone its complete stage of development, so that the best practice, from both the construction and safety viewpoints, is incorporated in the Code. Riveted pressure vessels built in accordance with the Code must be of flange or firebox steel. Working stresses are specified and certain details in regard to rivet spacing, thickness of straps and plates must be adhered to.

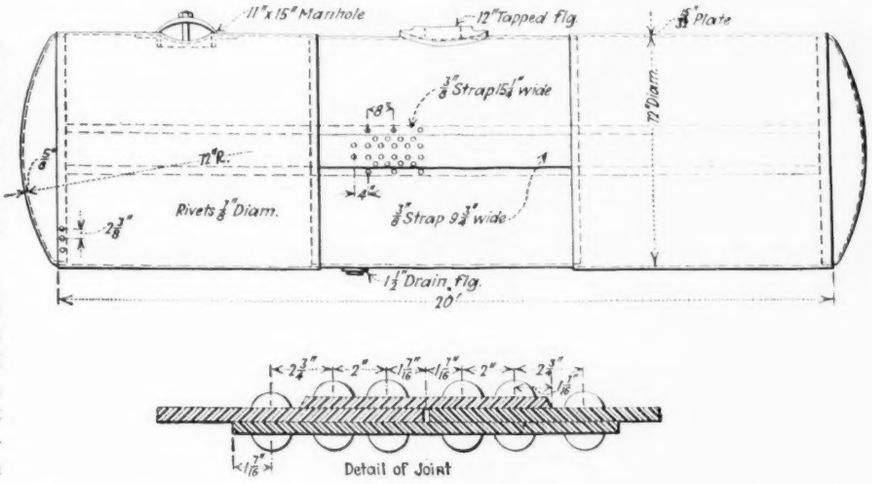


Fig. 3—Riveted air tank designed for 125 lb. working pressure in accordance with the provisions of the A.S.M.E. Pressure Vessel Code

Fig. 3 depicts a 72-in. diameter air tank, 20 ft. long, designed according to the A.S.M.E. Pressure Vessels Code for 125-lb. pressure. A plate thickness of $\frac{13}{32}$ in. is used for the shell courses. A minimum tensile strength of 55,000 lb. per sq.in. is assumed. The heads are of flange steel $\frac{5}{8}$ in. thick. The manhole is of the specified size and dimensions. The rivet spacing and strap thickness conform to the requirements.

Riveted vessels may be made of any number of plate courses. For large-sized boilers it is becoming the practice to limit the circumferential seams to the head seams only. There may be one longitudinal seam or two.

Calked riveted joints are not desirable for certain fluids such as ammonia, although entirely satisfactory for steam, water or air.

The tendency for increased pressures in boiler plants, culminating in plants of 1,200-lb. per sq.in., has caused new methods of construction to be introduced. These will be described in the next article.

Systematic Care of Generator Voltage Regulators

By R. B. GREENWOOD
Chief Operator, Moccasin Plant,
San Francisco, California

TROUBLES experienced when the regulators were first put into service and how these were eliminated. Inspection and maintenance methods that are being employed to keep the regulators in condition so that they function in a satisfactory manner.

AT THE Moccasin plant the voltage of each of the four 20,000-kva. generators is controlled by individual Westinghouse voltage regulators of the extended broad-range type. A 140-kw. exciter is direct-connected to each generator. A spare exciter, consisting of a 300-kw. motor-generator set, is also equipped with a voltage regulator, making a total of five regulators in the plant. The voltage regulators are identical and each is provided with ten rheostat-shunting relays, two master relays, one inverted relay and one vibrating magnet relay. Two reversing contactor switches, one auxiliary relay, one voltage relay and two direct-current control elements are included as part of the equipment associated with each regulator.

During the first few weeks after these regulators were placed in service, some difficulty was experienced due to the contacts of the rheostat-shunting relays building up. This action results from the use of excessive condenser capacity. The remedy was obvious, and the first change was to reconnect the two condensers across each pair of contacts in series. They were originally connected in parallel. With the series connection the sparking was too severe. After this trial one condenser only was connected across each pair of contacts, thus obtaining the desired operating characteristics and preventing building up of the contacts.

Oxidizing of Main Contacts

Another difficulty, somewhat annoying but never serious, was caused by the main contacts apparently oxidizing at the point of contact. This action resulted in a slightly burning and arcing of these contacts, which caused the operation of the regulator to become erratic and unsteady. This trouble was remedied by cleaning the contacts occasionally by drawing a piece of ordinary paper between them at a time when the regulator was cut out. The difficulty finally practically disappeared.

Each regulator is inspected monthly by the station electrician. One year's operating experience has indicated that three to four hours' work per month is sufficient to keep each regulator in first-class condition. This means that the regulators will operate satisfactorily for periods of at least a month without other attention than cleaning the armature stops.

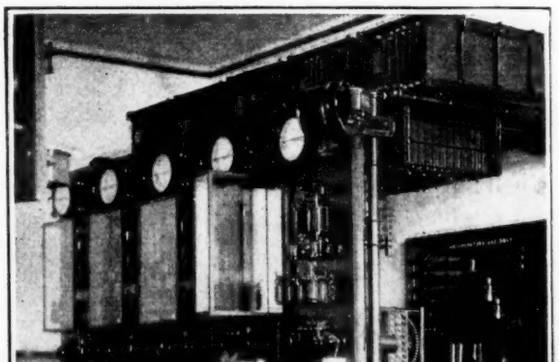


Fig. 1—Working on voltage regulator

Although the regulator cases are kept closed, it has been found that after a few hours' operation sufficient dirt and particles of metal accumulate on the armature stops to slow down the rate of vibration of the relays materially. It is therefore standard practice for the operators to clean these stops once during each eight-hour watch. This is done by merely drawing a strip of ordinary paper between the armature stop and the armature while the regulator is in operation. This cleaning can be done quickly and safely and has been found to improve the performance of the regulators.

Inspection of the Regulators

The first step in the operation of inspecting a regulator is to take it out of service, block it and issue a safety card covering the regulator to the station electrician. He then proceeds to the regulator blocked, taking a small wooden toolbox with him. In this box are all the tools required for regulator maintenance and spare parts (see Fig. 1).

First of all, the reversing contactor switches, which are mounted directly above the regulator cases, are carefully inspected and given such attention as may be found necessary. Occasionally, the contacts of these switches require filing and lubricating with white petrolatum, which is also used on all contact surfaces about the station that require lubrication. It is purchased in one-pound cans.

The next step is to inspect both dashpots of the main control element. In this particular installation the

main control dashpot is filled with dashpot oil, which is changed yearly. This dashpot is cleaned with gasoline at this time. The vibrating dashpot contains distilled water beneath a ½-in. layer of dashpot oil. This dashpot is also cleaned at yearly intervals, using hot water and Ivory soap. The magnet cores are removed to facilitate cleaning the dashpot plungers. The needle valves are also cleaned when the dashpots are emptied.

After cleaning, the dashpots are refilled with new oil or water and oil, to the upper line at the side of the dashpot window. Liquid is added periodically, when its level approaches the lower graduation, by using rubber-bulb eye droppers. Care must be taken to inject the distilled water beneath the oil seal to prevent mixing the oil and water. The formation of a complete oil seal above the water requires from seven to ten days.

Dressing Up the Main Contacts

After the dashpots are attended to, the main contacts are inspected and dressed by using a small round-edge oilstone when found necessary, care being taken to remove as little metal as possible and to retain the ball shape of the upper contact. The upper contact is ground in a small amateur's lathe. The bell crank is next tried with the hand for play in the pivot bearings. A slight amount of play, the proper amount being apparent after a little practice, is essential for the normal operation of the regulator. The main contacts are adjusted after first inserting a pin that blocks the levers and magnet cores in their central positions. The final

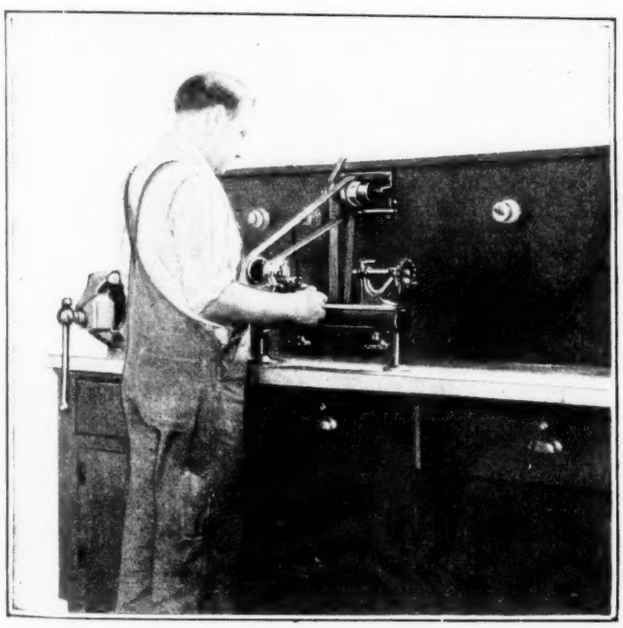


Fig. 2—Small lathe on electrician's bench used for repairing regulator contacts

adjustment of these contacts is made so that the shunting relays will respond to the slightest touch of the lever system, after which the pin is reversed. This adjustment is not made, however, until after the vibrating relay has been adjusted.

The vibrating relay, master relays and the inverted relay are in the same case as the main control element, hence are next given any attention necessary. The contacts of these four relays require but little care.

The ten shunting relays are inclosed in a separate glass case. These, together with the relays referred to in the preceding paragraph, are classified as vibrating relays and will be so termed in this article. The shunting relays short-circuit the exciter rheostat and, being subjected to heavy duty, require more attention than other parts of the regulator. The first step in checking all the relays (fourteen) of the vibrating type is to examine their contacts carefully. Contacts that

S.H.P.O.Form 48

ROUTINE INSPECTION SHEET

Voltage Regulator

City and County of San Francisco — Moccasin Power Station

	Item	X1	X2	V	Z	1	2	3	4	5	6	7	8	9	10
CONTACTS Upper	Checked	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Adjusted														
	Dressed														
	Replaced														
CONTACTS Lower	Checked	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Adjusted														
	Dressed														
	Replaced														
SPRINGS	Checked	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Tightened	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Replaced														

CONTACTS Item	Main S	Main M	S.C.d.c.Control S	S.C.d.c.Control M	G.F.R.d.c.Control S	G.F.R.d.c.Control M	Repeating Relay S	Repeating Relay M	C.V. Relay S	C.V. Relay M
Checked	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Adjusted	✓	✓								
Dressed	✓	✓								
Replaced										

Item	Stationary IN Upper	Stationary IN Lower	Movable IN Upper	Movable IN Lower	Stationary OUT Upper	Stationary OUT Lower	Movable OUT Upper	Movable OUT Lower
Checked	✓	✓	✓	✓	✓	✓	✓	✓
Adjusted								
Dressed								
Replaced								

Item	Dashpots: Main Control	Dashpots: Vibrating	Dashpots: G.F.R.d.c.Cont.		Pivots: Bell Crank	Pivots: F.Lev.
Checked	✓	✓	✓	Checked	✓	✓
Adjusted	✓	✓	✓	Adjusted		
Filled	✓	✓	✓	Replaced		

Item	Condition 100%	Condition 50%	Condition 25%		Condition 100%	Condition 50%	Condition 25%
Comp. Ohmic	✓			Rear V. Adj. Rheo	✓		
Comp. Cross Current	✓			Front V. Adj. Rheo	✓		
Comp. Line Drop	✓			Rear Panel Conn.	✓		
Condensers	✓			C. Weight & Spring	✓		
Resistors	✓						

Remarks: Cleaned and refilled all dashpots.

Regulator No. 1 Date 2-16-27 Inspected by D. Mirk.

Fig. 3—Monthly report sheet for work done on each regulator

are not in first-class condition are usually removed and replaced with new ones, or with those that have been previously put in good condition. This procedure is followed to reduce to a minimum the time that a regulator will be out of service, it usually being difficult to carry on regulator maintenance work at a time when the generating units are shut down.

Besides special wrenches that are very useful, the manufacturers provided a gage for spacing the contacts of the vibrating relays. The normal spacing is 0.014 in., and to obtain good regulator performance this value should not be materially exceeded. This means that even if the contact surfaces are in excellent condition, it may be necessary to shift the moving contact to maintain the proper spacing. It is important that all vibrating-relay contacts be secured tightly and that they register squarely.

Reconditioning the Relay Contacts

The moving contacts of the relays of the vibrating type are reconditioned in an amateur's bench lathe mounted on the electrician's workbench, as shown in Fig. 2. While purchased for the purpose of smoothing voltage regulator contacts, this lathe is useful for numerous small jobs, and is used frequently. It is belt-connected to a ¼-hp. single-phase motor.

The moving contacts are held in a universal chuck. Those used on the shunting and inverted relays are faced off at the contact end by means of a tool clamped in the tool rest, then removed and finished with a few strokes of a fine file. The moving contacts used on the vibrating and master relays are also finished in the chuck, but the lathe tool is not used in this case, all dressing being done with a fine-cut file and a fine round-edged oilstone.

A jig has been constructed for holding the stationary contacts used in the relays of the vibrating type. These contacts are riveted to flat steel springs, therefore cannot be held in the lathe chuck. This jig is provided with a taper shank for fitting into the lathe spindle. The face of the jig is slotted for receiving the contact spring, which is clamped in the slot by a thin disk through which the contact protrudes. The disk is clamped to the face of the jig by a flat-head machine screw. Two disks are required, one for the shunting relay contacts and one for the contacts of the vibrating and master relays.

Shunting Relay Contacts Require Little Attention

Occasionally, shunting relay contacts that require but little attention are touched up without being removed, by using a magneto file. But since the work of smoothing contacts can be done much more accurately and speedily in the lathe than by ordinary hand filing, the lathe is generally used. It is rather difficult to finish the end of a contact square by using a file only.

The auxiliary relay that is required for automatically paralleling the voltage regulator requires but little attention, yet like all other parts of the regulator it is carefully inspected. The two direct-current elements likewise require but little care, for the duty imposed on their contacts, the parts subject to most wear, is quite light. The contacts of the direct-current elements are smoothed with a stone when necessary. The oil-filled dashpot on the element that actuates the reversing contactor switches is given the same attention yearly as the dashpot on the main-control magnet.

The voltage relay is blown out yearly and, being of the induction type, requires practically no attention.

After all regulator relay contacts are dressed and adjusted, all connections and parts are carefully inspected and given any attention necessary. The armatures of all the vibrating relays are spring-mounted and operate satisfactorily for long periods without requiring maintenance or replacement. After being put in good condition, the parts within the regulator cases are blown out with compressed air by using a very small nozzle.

Care of the Knife Switches

All the numerous knife switches associated with the regulator are inspected and kept lubricated so as to operate freely. Possible loose connections and parts showing excessive wear are carefully watched for. A loose connection may lead to serious operating difficulties. Wear of regulator parts is confined mostly to contacts, the pivot sockets, while requiring occasional adjusting, lasting several years.

The group of resistors associated with each regulator and the wiring on the back of the regulator panel are blown out monthly by the operators. The glass cases of the regulators are cleaned monthly, also by the operators, ammonia and water being used. The button contacts of the rheostats associated with each regulator are lubricated monthly.

To insure satisfactory operation the armature springs of all the vibrating relays must be kept in correct adjustment. The tension of these springs is checked monthly by energizing the relay winding with 65 volts instead of the normal voltage of 125. At 65 volts the spring adjustment must be such that the armature will just float; that is, remain in the mid-position of its travel and move up or down by a light touch of the finger. The relay windings should be warm when this adjustment is made.

The low voltage required for making spring adjustments is obtained by connecting the regulator control circuit to one of the two control battery-charging sets by means of temporary leads. It is planned to run a third conductor from the station control battery to the regulator board so that the testing voltage can be obtained from this battery by using a single short jumper.

When the regulator springs were checked during the first few months of operation, considerable adjusting was found necessary. Now, however, very few changes in spring tension are required.

At the completion of the work done monthly on each regulator, the inspection sheet, Fig. 3, is filled in by the station electrician. This sheet was devised at Moccasin and forms part of the maintenance records.

As described in *Power*, March 22, the generators at Moccasin are started and stopped with the voltage regulators cut in. By following this method of operation, an over-all test results during starting and stopping, since all the equipment associated with the regulator is then required to function and any abnormal condition is disclosed. Although a regulator of the extended broad-range type is more likely to give trouble than one without the broad-range features, the regulators at Moccasin have consistently functioned remarkably well.

Preventing Trouble on Induction Motors Slip Rings

Since the slip rings of wound-rotor induction motors are short-circuited after the motor comes up to speed, the idea is prevalent that the voltage between these rings is low at all times. This, however, is not true if the rotor circuit happens to be opened through the starting device. Even with the rotor circuit closed through the starting resistance, when the line switch is first closed, the voltage between the rings is of such a value as to cause trouble unless the insulation of the rings is kept clean. After the rotor comes up to speed, the voltage drops to a low value.

With the rotor at standstill and a short-circuit between the rings, the rotor is likely to lock if an attempt is made to start the machine, this being a characteristic of this type of motor. Therefore care should be taken to keep the insulation on the rings free of carbon and metallic dust. The space between the rings is likely to be neglected and oil and conducting materials allowed to collect. Under such conditions, each time the motor is started a current leak occurs between the rings, which eventually causes the insulation to fail. In some cases an arc is formed on large machines that is likely to do serious damage to the rings and insulation.

An Engineer's Art of Getting Things Done

By JAMES F. HOBART

JIM SHIPLEY was one of those engineers who enjoyed taking hold of a run-down plant and bringing order out of chaos. This was the basic reason why he accepted the job of engineer for the Millville Feed & Fertilizer Co. Just how he was able to induce the tight-wad owner to spend some money for improvements speaks volumes for his ability as a salesman. When Shipley approached the proprietor, about a few dollars for repairs, Smith's reaction was the expected one.

"NO, MR. SHIPLEY," remarked Peter Smith, proprietor of the Millville Feed & Fertilizer Co., "I'll not spend a dollar fixing up that engine room or boiler house. It used to be a fairly decent place until the last engineer got hold of it two years ago, and if they call the engine a rattlebox or a junk pile, it's not my fault.

"Go to it, if you care to tackle the job," he continued. "One engineer ran the plant down without any help from me, and some engineer will run it up again, if the plant ever does get up."

Shipley thought there was a lot of static in this broadcasting, but as he needed the money, he took the job. The following Monday morning he went quietly to work without any loud talk or promises of alarming changes. But steadily, bit by bit, he cleaned the junk and dirt out of the corners of that engine room, finding places for wood and junk outside and putting nuts, washers, screws and other usable material in empty cans or tin boxes. All this clean-up work was not done in a day or in a week. While the junk was disappearing, a lot of steam quit blowing out of leaky packing glands. Knocks in the connecting rod and shaft bearings, as well as one baffling noise caused by a loose key in the engine pulley, soon disappeared.

The steam-boiler feed pump was no longer enveloped in a cloud of steam every time the pump was started. Leaks disappeared from the blowoff and whistle valves. Shipley opened the boilers and removed dirt and loose scale from inside of the shell and scraped wheelbarrowloads of dirt and soot from the tubes, shell and boiler heads.

"Two barrowloads less coal to wheel each day," he

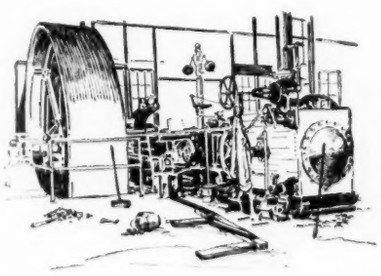


Fig. 1—The engine room looked like a junk yard

chuckled to himself a few days after the boiler clean-up. "Bet I cut off a lot more coal wheeling before I get through."

After the dirt and the junk had been removed from the floor and corners of the engine room, vigorous and persistent application of shovel, hoe, broom and elbow grease worked wonders with not only the floor but also the walls, ceiling and windows. Such a change was made in the room's appearance that even a truck driver

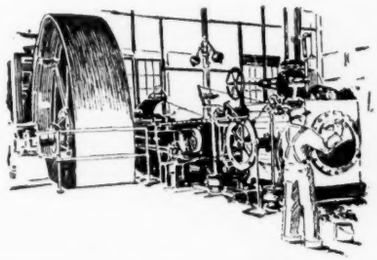


Fig. 2—A little paint and cleaning up changed things

stamped his feet and scraped his boots upon the ground before entering.

On one side of the engine room a pretty good workbench was uncovered, also some drawers and a locker for clothing. Besides, a number of tools were also dug up. The engineer bent and ground the end of an old flat file into a scraper and went for the caked-on grease and dirt that covered most of the engine. Later, he invested in some cans of lye and a wire scrub brush. In a short time every vestige of grease and dirt had disappeared from the engine.

While looking about the factory, Shipley had noticed several pots and cans with paint and oil in the bottom of some of them. The factory foreman was asked if the engineer could have some of the paint material. The foreman told him to help himself, that he was glad to be rid of the stuff, which was drying up and going to waste. A pot of brushes that was under the bench was also turned over to the engineer.

Shipley gave all the engine parts, except the bright work, a coat of battleship gray, as also the concrete base. He was just putting the finishing touches to a maroon-colored finishing coat of paint on the engine, when the engine-room door opened and Peter Smith, the factory owner, walked in. His eyes popped out in amazement.

He gasped, caught his breath and exclaimed, "Where did you get that engine, and where is that junk-heap thing that used to be here?"

The engineer explained what had been done and how. As Mr. Smith listened intently, a smile gradually crept over his face.

"Young man, you have done a good job all by yourself and have shown that you have it in you to help yourself. That's just the kind of a man I like to help So if you need some other things to improve this plant,

then just step over to my office and we'll talk the matter over."

The engine cylinder had been drilled and tapped for attaching an indicator, so Shipley constructed a reducing motion from odds and ends found around the place. An engineer friend owned an indicator which he brought over one day and attached to the engine. After a considerable number of diagrams were taken under varying factory loads, Shipley put them in his pocket and went over to Smith's office.

"Sit right down here, Mr. Engineer," said Mr. Smith, pushing a chair toward him. "What's on your mind? Want to order a dozen pairs of smoked spectacles so the visitors to your engine room won't have their eyes dazzled by the exceedingly great brightness out there? I hear that half the town has been out there to see that."

"Hardly that, Mr. Smith," said the engineer with a grin. "But I have come to ask you to spend a little money for smoked spectacles to be worn by the boiler furnace."

"How is that? I don't quite understand."

"Here are some indicator diagrams from your engine," replied Mr. Shipley, exhibiting the diagrams and sheet of measurements. "These diagrams and calculations show that your engine is using a lot more steam than is necessary to produce the power actually developed. It needs a new set of piston rings, and regrinding the valves would reduce the steam consumption very much. Reboring the engine cylinder and fitting it with a new piston and rings would make a decided and worth-while saving in coal consumption."

"Well, Shipley, what you say sounds very good to me. Have you checked your figures and made sure that they are correct?"

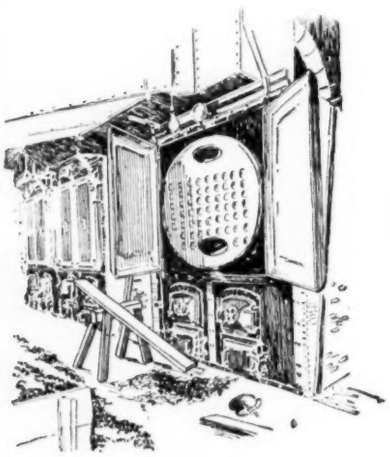


Fig. 3—The boilers received their first cleaning

"Yes, Mr. Smith, and I have also made an estimate. Check the engine output against the coal consumed and you will see that the consumption of fuel is far greater than it should be."

"I believe you are right. I will send a machinist from the shop. Go over the matter with him, tell him exactly what you want, and arrange with him to do the work over the week-end, with the least possible loss of factory time."

Engineer Shipley proceeded to have the cylinder rebored, new piston and rings put in place, and the valves reground, without losing a single hour of factory time. The results proved so satisfactory to Mr. Smith that his Christmas gift to Shipley was a good steam-engine indicator and a substantial addition to his pay check.

Still further reductions in the fuel bills were caused by the engineer, who covered hundreds of feet of steam pipe with heat-insulating material and watched for and squelched unnecessary steam leaks all through the factory.

One day Smith called Shipley into his private office and said, "Shipley, we have got to have more power. Increased business will force us to put in more machinery. Here is a list and it is up to you to figure out how to do it. Will it be best for us to put another engine into service, or to discard the present one for a larger one? Also, what changes or improvements must be made in the boiler room?"

Fig. 4 — The owner finds it is economical to be a spendthrift

"I can answer that question right now," returned Shipley. "We won't need another engine, either. Our old engine has not worked up to its full capacity. It can be run 20 per cent faster, which will give us that much more power, and 10 per cent more load may safely be added at its present speed. This engine can be depended upon for at least 30 per cent more power than it is developing at present.

"As for the steam boilers," he continued, "they are capable of giving more power than they are developing at present. If you will permit refinement appliances, such as feed-water control and CO_2 analysis apparatus, I feel sure that we can increase the boiler efficiency at least 20 per cent."

Reading tooth paste advertisements has the writer spoiled of a moral attached to the end of a story, and one will not be added here. Nevertheless, Shipley is just an example of an engineer who tries to do things for himself.

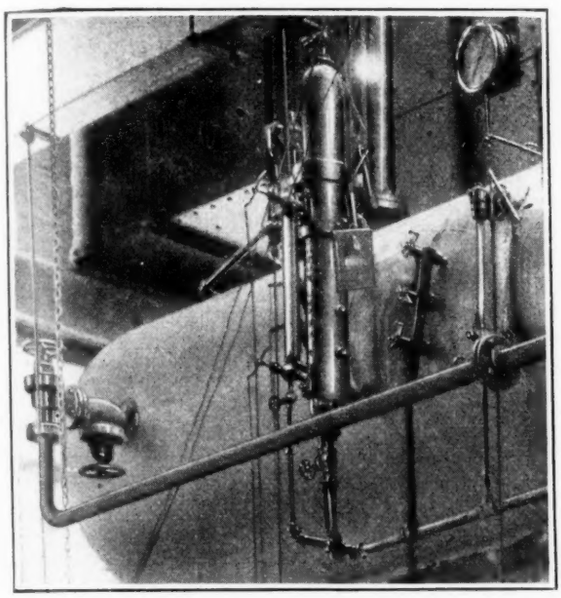
60,000-Kw. Turbine at Buffalo

The capacity of the Charles R. Huntley station of the Buffalo General Electric Co. has been increased to 155,000 kw. by the recent installation of a 60,000-kw. turbine-geerator. This steam plant, formerly known as the River Station, has been in operation ten years and is used as a steam auxiliary on the large hydro-electric system, to carry the normal peak loads as well as peaks brought on by emergencies. The plant therefore has a wide variation in load over the 24-hour period.

The station includes five steam turbine generators: three 20,000-kw. units, one 35,000 kw. unit and the new 60,000-kw. unit. The new machine, of single-unit General Electric type, is one of the largest now in service using this form of construction. It is rated 66,667 kva., 90 per cent power factor, 1,500 r.p.m., 25 cycles, and operates at 250 lb. gage, 250 deg. F. superheat, and 1-in. absolute back pressure.

The equipment includes a solenoid-operated valve which permits automatic adjustment of the load from a wattmeter relay, to hold a constant load on the turbine.

What About the Water Level?



By BENJAMIN J. PARKER

IS THE water level in the water column ever the same as that in the boiler shell or drum? Maybe sometimes, but when, and can one be sure about it?

THESE questions, the old heads will say, are "old stuff," but they have a practical value that applies to everyday's operation of the steam plant. If the water level in the boiler is one-half inch higher than the level observed in the glass, it can cause no end of trouble and great loss of economy.

Here is what happened in a plant where I was assistant engineer. There were five water-tube boilers of the longitudinal drum type. "Came a day," as they say in Hollywood, when we never knew when those babies were going to prime and send us scurrying for the throttles on the big mill engine and the generating sets.

We were daily increasing the load on these boilers, and although we were still under 60 per cent at this time, the old chief said the boilers were overloaded, and let it go at that. But a couple of us knew that they were not overloaded except along toward the latter part of each month, when one boiler would be due for cleaning.

A New Man on the Job

Just about that time the old chief was fired and an efficiency engineer was employed. We liked the old chief, even if we did call him names, and we were downright suspicious of the efficiency bird. The new man said to me one day, "Let's go in and figure the steam liberating area in those boilers." So we went in the drum and measured the length and breadth of the surface of the water at the points where it ranged in operation.

We came out of the drum and went into the office and figured and found the liberating area to be just about enough when the water was at the level of the top of the manhole plate in the rear end of the drum. Next, we figured the area with a rise of one inch in the drum, and then "I beheld a great light" on the priming problem that was giving me gray hairs.

We gave orders to blow down to one-half inch of water in the glasses and to hold that level for 24 hours. The priming occurred but once in that period, and that was at 4 a.m. You know how it is—the water isn't very visible at that hour in the morning, and our drowsy boys were going to be sure they didn't start some tubes leaking. Anyway, the priming wasn't severe.

The next day the expert—sure, by this time he and I were old pals—now told me about the unbalanced U-tube effect in the water column and said he was going to call up the chief boiler inspector and get permission to lower the water columns two or three inches.

The Inspector Had To Be Shown

He didn't get permission over the phone, but we did get a stormy visit from the chief boiler inspector.

We measured and measured, and finally filled the boiler and put a quantity of lime on the water to get a sure water mark on the shell and marked the water level in the glass with a string, and found that the bottom of the glass was nearly one inch above half drum level and four inches above the fire line.

Now, then, comes the false level of the water glass. Just imagine where our liberating surface was with three or four inches of water in the glass, the level that we normally carried.

Remember, we religiously blew the water columns every hour. But no one ever took seriously the high level in the glass that showed just after blowing the column.

One fellow put it that after blowing the glass the water that came up the glass was full of steam and, consequently, was expanded and higher than it would be after it stood a moment or two. True enough!

When we demonstrated to the chief boiler inspector that our water level was still above the fire line on the drum with about three inches of water above the mouth of the front header even when the glass was lowered

three inches, he consented to permit two inches on that boiler—"But mind you, if you want to monkey with the other boilers like that, let me know and I'll come over and see what you do." Chief boiler inspectors are like that—it's what makes 'em get that way—to be chiefs, is what I mean.

We went right down the line and lowered all the glasses approximately two inches, and our boilers never primed after that, and what is more, the factory where there were a lot of heating vats and the paper machine declared we were raising the pressure or getting too much heat in the steam, because they couldn't open the inlet valves on their machines wide as they always had done, for the coils would get too hot, and our fuel-oil consumption began to show four, five and six barrels less per 24 hours. But the expert and I weren't through yet—I should say, "the expert and his assistant."

Dry Steam Saves Fuel

We brought the fuel consumption down ten barrels per day and increased production or power output 20 per cent, just on dry steam production alone. And we—but that's another thing; let's get back to the level—you may say this is an exceptional case, but it is exceptional in degree only. For since that time I have become a boiler inspector myself, and I've seen hundreds—yes, thousands—of boilers with this same trouble. You know the oil fields? Well, then.

And in many cases I've talked quietly to the chief of the plant about it, and generally they say, "You say how much to drop her, and I'll do it." "No sir," say I, "you take your time and measurements, and see what it should be; then let me know what you want and I'll tell you if you may." Just like the old chief, only not so old or so wise.

Think it over and size up your boilers. The greater your liberating surface the drier the steam within the latitude of your boiler rating.

Why the Water Column Reads Low and How to Fix It

If the water connection to the water glass is long and you can't shorten it in a practical way, cover it with pipe covering and mark high, mean and low cold-water levels on the column or boiler front. Every pound of water that goes out of the boiler as water is that much fuel wasted (not a pound of fuel, but the amount of fuel required to heat that water at your plant operating conditions).

At 212 deg. F. water has a volume of 1.0432[1] and at the approximate pressure of 215 lb. or 382 deg. F., the volume is 1.1544, so assuming that the water in the glass and column cools only 170 deg. F., this gives a difference in volume of 1 in 10, and this would give in the average case at least one-half inch difference between the water level in the glass and the water level in the boiler; that is, the water will be one-half inch higher in the boiler than in the water glass. These estimates are, of course, only approximate.

The level showing in the glass is never the true level except when the boiler is cold, and how correct that level is for a safe level in any boiler each must determine for himself.

If you operate your boiler with more water than a safe level requires, you are wasting fuel just by heating up a volume of water that you can't use. Don't imagine you are storing up heat in that water to draw on later. Radiation has a lot to say about that, and if your water level is too high you are probably generating wet steam constantly. This is a source of sinful waste of fuel, and mayhap the secret cause of much grief in the distribution system of heating coils and the like.

Many other interesting phases of the condition outlined have come to my attention in my travels, but the space is overfull now.

[1]These figures are in cubic centimeters per gram and correspond to the values 0.0167 and 0.0186 cubic feet per pound.

Types of Drives for Hydraulic Turbine Governors

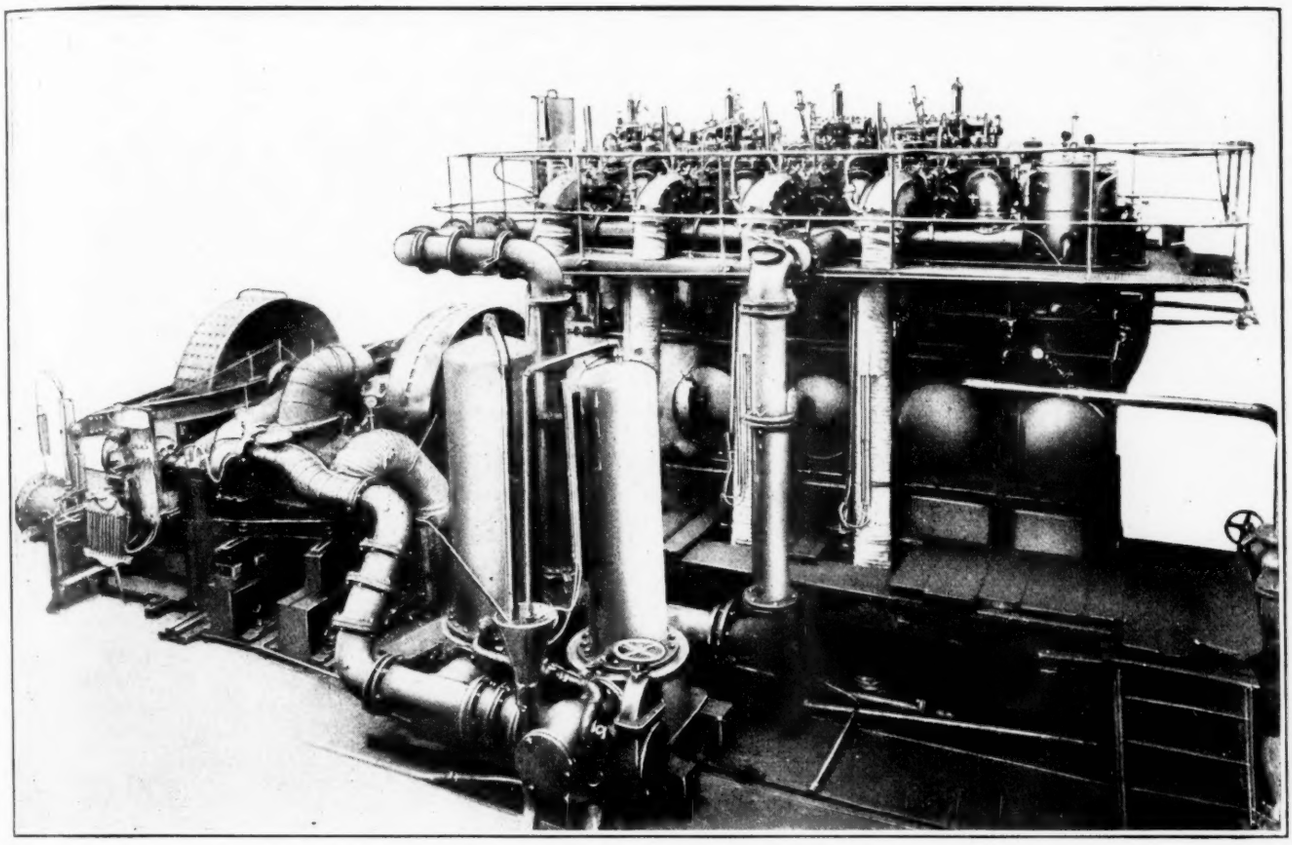
The belt drive, with idler, is reported by the Hydraulic Power Committee of the National Electric Light Association, as giving general satisfaction, particularly where the double-belt drive is used on waterwheels. No case of both belts breaking at the same time was reported. Some companies reported satisfaction with gear drives, chain drives and direct drives.

Several companies reported experience with the use of motor drives. One company disapproves of this drive since the governor pulled out of step in cases of trouble when the generator field was weak, while another anticipates such trouble, but on the whole feels the drive is satisfactory. Such a drive should be connected between the generator and the main switch with such protective devices on the conductors leading from the governor mechanism as the individual designer or operator believes most suitable.

Several companies expressed opinions regarding motor-driven flyballs operated from an auxiliary generator on the mainshaft of the unit. No definite operating experience was, however, reported, although one company has three 70,000-hp. units equipped with auxiliary generators mounted on the mainshaft, the motor-driven governors not having been installed as yet.

The general opinion seems to be that this form of drive is preferable to and more dependable than motor drive from the main generator leads or busbars. Some members of the committee expressed a distrust of the efficacy of protective devices on governor leads connected to the main generator lead, and for that reason expressed a preference for the use of an auxiliary generator as previously mentioned.

To Clean Atmospheric Ammonia Condensers of scale, a stiff wire brush and a hammer will do the job. From double-pipe condensers the scale must be removed by a drill or tube cleaner. All gaskets on the condenser should be renewed once a year. Rubber gaskets wear and rot, while lead gaskets quite often give enough to leak, so all should be inspected and renewed. If the several stands do not work evenly, the water supply may be unevenly distributed. One of the stands may be partly closed off by the valves being improperly set. Only by experimenting can the engineer discover how to make each coil do its share. To determine whether coils are condensing alike, see that an equal amount of cooling water is supplied to each coil, and then feel the ammonia gas inlet to each coil to see that they are all the same temperature; also feel the last pipe where the ammonia leaves the coils.



Cheaper Oil-Engine Power Probable by Supercharging

Supercharging Four-Stroke-Cycle Diesel Engines with Exhaust Turbo Blower Increases Power Outlet and Decreases Fuel Consumption

By ALFRED BÜCHI,
Consulting Engineer, Winterthur, Switzerland

THE Swiss Locomotive & Machine Works, Winterthur, in collaboration with Brown, Boveri & Co., Baden, Switzerland, has lately carried out a series of tests on supercharging a four-stroke-cycle Diesel engine. These tests show that it is possible to obtain more power from a given cylinder without an increase in the unit fuel consumption. Supercharging is proved to be a logical means of lowering the initial cost of a Diesel installation.

The experimental engine was also chosen so large that the results of the tests may be considered as applying to all engines over a wide range of power. The engine was a normal four-cylinder 500-hp. four-stroke-cycle Diesel, altered to permit its charging with air under pressure and exhausting with back pressure into an exhaust-gas turbine. The exhaust turbine had one wheel and a single stage, while the charging air blower had two stages.

This set was originally built for another purpose, but it was altered slightly for these tests. Even with these changes it was not possible to attain results such as would be given by a gas turbine and charging-air blower especially built for the purpose. A small electric motor was therefore fitted to the blower, making it possible to obtain nearly as high an output as would be given when driven by a properly dimensioned exhaust-gas turbine. It was possible, by greater or less co-operation of the electric motor, to investigate the behavior of the gas turbine at various efficiencies. For given quantities of exhaust gas and charging air, the turbine makers are at once in a position to give exact particulars of the blower efficiency that can be attained. For an 800- to 3,000-hp. engine it is approximately 43 to 50 per cent.

The long series of experiments with this exhaust-gas turbine set has also enabled much valuable experience

to be gathered regarding many technical points as to the proper design and construction of the turbines and air blowers. Before entering the cylinder, the charging air delivered by the compressor should pass through coolers, so that the engine can work with cooled or with uncooled charging air.

The arrangement shown in the head-piece is a purely experimental arrangement and quite different from the definite and very simple arrangement to be adopted for a standard engine. Since only existing engines and accessories were used, the arrangement was rather a rambling one, particularly with regard to the piping for the charging air, exhaust gases and coolers. In spite of this the results obtained were quite remarkable. The most important are given in Fig. 1.

Cylinder Pressures Unchanged

Testing the engine with supercharging air was effected by taking the normal output, as that at which the exhaust temperature measured beyond the exhaust valves was the same as that of a Diesel engine working without supercharging. The compression space in the engine was chosen of such a size that, in spite of the adopted charging-air pressure of from 6 to 7 lb. per sq.in. gage, the maximum pressure in the working cylinders remained about the same as in an ordinary Diesel engine, so that the running gear and crankshaft are not subjected to any greater bending stresses. In consequence of the increased turning moment only the torsional stress in the crankshaft is increased, but this is not a serious matter since the increase is far from being as large as that in two-stroke-cycle or in double-acting four-stroke-cycle engines, where the diameter of the crankshaft is not increased anything like in proportion to the increase in the turning moment.

Summary of Results

The main results of the tests may be summarized as follows: By adopting a charging-air pressure of 7 lb. per sq.in. gage, the output of the engine can be increased by 50 per cent, while still maintaining the usual exhaust temperatures of a standard Diesel. With regard to a further rise in output in excess of the normal, the engine with a supercharging blower driven independently by an exhaust-gas turbine has an advantage, since the speeds of the turbine and blower increase when the output rises. The blower therefore delivers more charging air, and the engine can consequently consume more fuel and take a much greater overload than an ordinary Diesel. The experimental engine has often been loaded up to 1,000 b.hp., the exhaust conditions remaining quite good. This load is 40 per cent above the output of 750 hp., which is already 50 per cent above the output of a normal Diesel engine of similar cylinder dimensions. Consequently, the comparatively simple addition of an exhaust-gas turbine driving an air blower enables the normal output to be raised by 50 per cent, and in addition the engine is given a high degree of overload, the lack of which is often found to be a great drawback in Diesel engines.

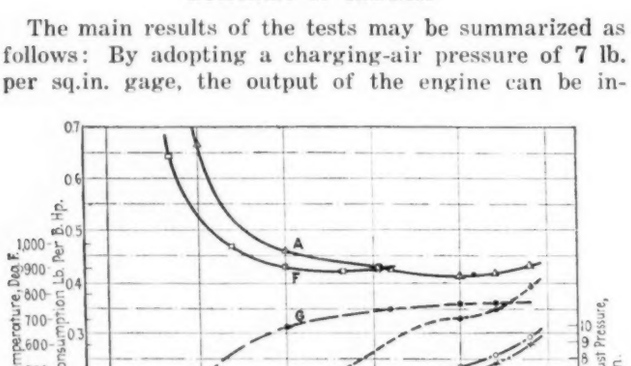


Fig. 1—Test results with supercharging

A, fuel consumption with exhaust turbine in action; *F*, fuel consumption without turbine; *B*, exhaust gas temperature; *C*, scavenging air pressure; *D*, exhaust-gas pressure at turbines; *E*, mean effective pressure; *G*, increase in efficiency of the turbine.

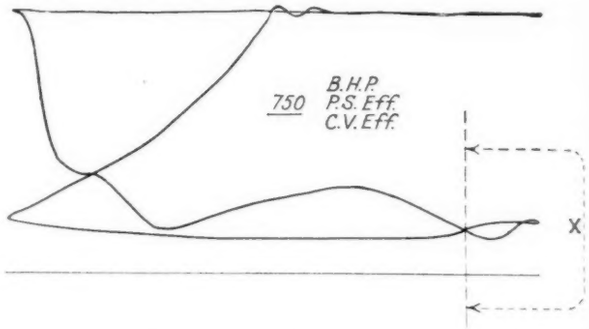


Fig. 2—Exhaust conditions at normal rating

Future of Possibilities

The future prospects of this type of engine are exceptionally good, whether as a stationary engine for taking peak loads and serving as stand-by, or as the propelling medium for locomotives and ships. As already stated, in the experimental engine the maximum pressures were kept within the limits usual in normal Diesels. At its normal load of 750 hp. the engine works under the same conditions of heat stresses as a 550-hp. Diesel with the same cylinder dimensions. Not only are the exhaust-gas temperatures the same, but the amount of heat carried away in the cooling water is also the same.

It has been found that, with an output of 750 hp., about 1,200 B.t.u. per b.hp.-hr. is carried away from the cylinders and cylinder covers. In a four-stroke-cycle Diesel of similar construction and running at the same speed, a much greater amount of heat is carried away—about 2,040 B.t.u. The total quantity of heat carried away by the cooling water is, therefore, somewhat less in the engine supplied with supercharging. This of course can only mean that the cylinder walls of an engine charged in this manner are less stressed by the heat than is an ordinary Diesel developing about 30 per cent less power. These results stand in sharp contradiction to many assumptions that have been made, based on small-scale experiments or erroneous theoretical views.

No Unusual Stresses

When the conditions are more closely examined, it will at once be recognized that nothing else is possible. If the charging air is cooled before being introduced into the cylinders, as is done in the test engine, and if the rate of fuel consumption, as is the case, is no higher than in an ordinary Diesel, it stands to reason that the

quantity of fuel introduced into the cylinder will not increase the temperature of combustion, because when the proportion of air to fuel is the same as before, the temperature of combustion will also remain the same. Certainly, in the charged engine the indicator diagram will be somewhat broader; the maximum temperature during the combustion stroke lasts somewhat longer and the temperature at the end of the stroke is slightly

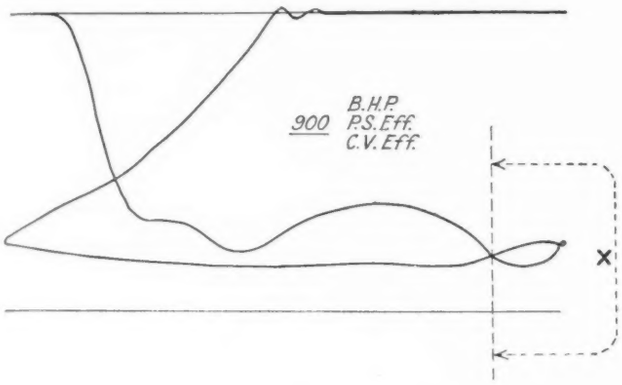


Fig. 3—Exhaust and charging at overload

higher. But on the other hand the temperature of the air introduced to the cylinder is somewhat lower at the same pressure as exists in an ordinary Diesel, owing to its greater amount and because it is slightly compressed and again cooled; during the suction and compression strokes the temperatures are, therefore, lower than in an ordinary Diesel.

Completed Scavenging Assured

However, in the engine tested, there are two further factors that have a decisive influence in reducing the exhaust-gas temperature and the quantity of heat carried away from the cylinders by the cooling water. In this engine the conditions of working are such that during the exhaust stroke the pressure at the turbine can be adjusted to be equal to the charging-air pressure or even less than it; the working cylinders are, consequently, almost entirely emptied of the exhaust gases. As the load on the engine increases, this effect becomes more pronounced, as can be seen from the weak-spring diagrams in Figs. 2 and 3. The period *X*, during which the exhaust pressure is lower than the charging-air pressure, is also utilized to scavenge the cylinder effectively with cold charging air. In this manner about 20 per cent of the scavenging air can be blown through the cylinders causing the upper parts of the cylinder walls and the exhaust valves to be cooled effectively. This explains the low temperature of the exhaust gases at normal load and overload and the small quantity of heat carried away in the cooling water. Of course, in order to utilize the scavenging period well, the timing of the inlet and exhaust valves must be different from that in an ordinary four-stroke-cycle engine where there is no scavenging action.

Indicator diagrams taken on working cylinders at various loads are given in Fig. 4. The typical form is that of the standard Diesel diagram, except that in the lower part there is a loop above the atmospheric line caused by exhausting and charging at higher pressure.

In commercial engines, the gas turbine and charging air blower will be fitted as closely as possible to the engine. The exhaust turbine can be set at one end of the engine, with its axis at right angles to the axis of the engine in order to simplify the piping.

The method of charging described is not only applicable to new engines, but can also be adapted at once to existing units by fitting an exhaust-gas turbine, a charging air blower, and by making a few quite insignificant alterations to the engine. This will enable the output to be raised by about 50 per cent if the speed of the engine is kept the same as before. The Vulcanwerke Hamburg engines of the motorships "Preussen" and "Hansentadt Danwig" work in this manner. In these cases the normal Diesel engine output of 1,700 hp. per engine has been increased to as high as 3,100 hp. although the charging air is not cooled at all.

Cooling Water Needed

The quantity of cooling water required is about 30 per cent less than in ordinary four-stroke-cycle engines of the same output, on account of the smaller quantity of heat that has to be carried away. Also less lubricating oil is used, since the lubricated surfaces are about the same size as those in a Diesel engine 30 per cent smaller.

The test engine has been running for about 10 months and no difficulty has been encountered with the exhaust-

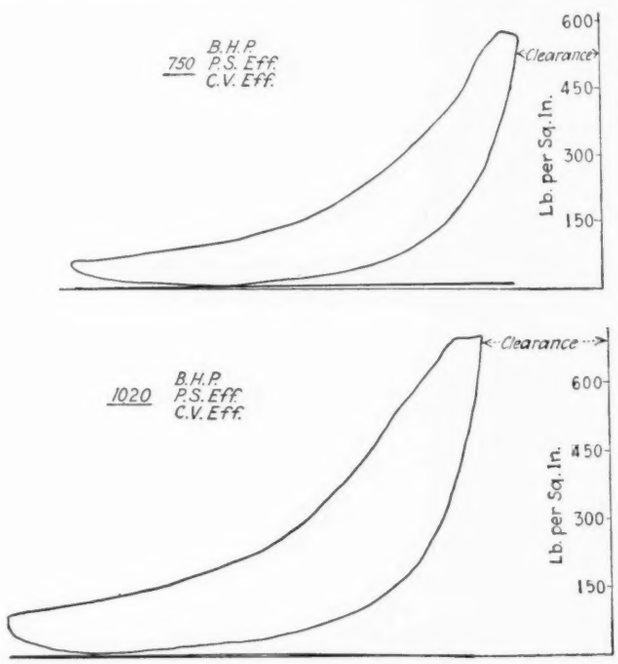


Fig. 4—Indicator diagrams taken at normal load and at overload

gas turbine. The blades resist the existing gas temperatures and the turbine remains clean. On the inner surface of the turbine and the piping one can notice only a very thin film of soot.

The application of an exhaust gas turbo blower can be made upon any standard Diesel with but a few changes, such as the length of the piston. Inasmuch as the engine power is largely increased, the general use of this device will result in lower cost per rated horsepower and should materially increase engine sales.

May 15th

is the last day

for the POWER *Prize Contest*

Tell what *you* have done to improve your plant operation

HERE ARE THE CONDITIONS OF THE CONTEST:

1 The manuscripts submitted will be judged on (a) the value of the results, not alone on savings in dollars, (b) ingenuity displayed, (c) general interest and applicability to other plants, (d) method of presentation.

2 The identity of the plant must be revealed in the text and the story must be subject to verification.

3 Articles should be as short as consistent with telling the facts; preferably not exceeding 40,000 words exclusive of illustrations, which are desirable.

4 All manuscripts should be submitted by May 15, addressed to *Power*, Tenth Ave. at 36th St., New York, and plainly marked "Entered in Power Prize Contest." The manuscripts should not be signed, but each should be accompanied by a letter of transmittal giving author's name and address. For the purpose of judging, such letters will be keyed to the manuscript and filed.

5 Articles which do not win prizes, but which possess sufficient merit to warrant publication, will be used subsequently and paid for at regular rates.

6 The competition is open to all without regard to position.

1st Prize $500
2d Prize 250
3d Prize 100

TO BE awarded by *Power* for the articles showing the most commendable improvements in the results obtained from the modernization, reorganization or improved operation of a power plant, during the last two years.

THE JUDGES

F. M. Gibson, *Boston* R. J. S. Pigott, *New York* A. C. Wood, *Philadelphia*

Less than three weeks to go!

A Standardized Fuel Oil Most Desirable

OIL companies, in answer to the complaint of high Diesel fuel oil prices, counter with the claim that high prices are direct results of the varied oil specifications under which the fuel is purchased. It is necessary to maintain stocks of probably ten grades, and someone must bear the investment expense.

Just why engine builders are so divergent in their recommendation of a suitable fuel is hard to understand. Certainly, there is an almost unanimity in the claim that any particular engine offered the prospect can burn any and all fuels. If this be true, why the later suggestion or recommendation that a special fuel be used? If Diesel engines will burn Bunker C oil, why ask for a distillate? The truth is that all engines do not react the same when placed on a diet of the heavy boiler oil, but many will and do handle it satisfactorily.

Standardization of Diesel fuel specifications is a step that should be initiated by the group of engine builders, the oil companies, or those companies using a great enough number of engines to cause these requests to have influence.

Household heating apparatus are consuming much of the lighter grades of fuel oil and since the home owner will pay a price beyond that which a Diesel user feels he can justify, the distillates will be beyond the latter's reach in a short time. Heavier fuels must be burned, and engine builders should recognize the situation. If an engine can handle boiler oil, the purchaser should not be encouraged to burn the more expensive oil, and if the engine cannot, the design should be modified.

It is folly to pay an unecessary price differential of one or two cents per gallon when satisfactory service can be otherwise obtained.

Service Record Story of Machine Performance

THERE are many factors that influence the service given by a machine. First of all come the design, quality of material used and the workmanship in its construction. Unless these are good, the machine may not give satisfactory service except it be under favorable conditions. Next to the quality of the machine are the conditions under which it has to operate, such as the nature of the load, surrounding temperatures, atmospheric conditions and how well the machine is suited to the work it is supposed to perform. Unless a service record is kept of a machine, the factors that influence its operation cannot be evaluated.

Not infrequently machines that are not suited to the work they are doing are kept in use and give fairly satisfactory service. This, however, is obtained at the expense of a large amount of maintenance, carried on by a capable workman. A poor machine in charge of an efficient maintenance man will frequently give better service than high-grade equipment that has less expert care. A service record will not only show what each machine is doing, but also give an indication of the quality of the men looking after it. If the trouble is in the machine or the application and the maintenance costs are excessively high, the solution to the problem may be a new machine suited to the conditions. Where the trouble is in the maintenance practice, the record will show this by the nature of the repairs and how they came to be necessary.

When purchasing new equipment, service records of the old machines may provide an excellent guide. If the old equipment has not been entirely satisfactory, the records will show where the machines failed and what improvements are necessary to insure better service. A satisfactory machine does not necessarily indicate the most economical one for the load, as the machine may be entirely too large for the service, in which case this should be known from the records of past performance and new equipment selected of a size to correspond more nearly to the load requirements.

Properly kept records tell a complete story of machine performance and not only make possible an intelligent study of the methods best suited to the conditions, but also show where changes can be made to keep down costs and improve service.

Co-operation Necessary To Make Standards Effective

IN AN industry with the almost limitless ramifications of the electrical, the number of sizes, shapes and grades that may develop in a certain article is astounding. Almost every one connected with the industry has in some way to do with carbon brushes, but how few stop to think of the tremendous number of varieties that have come into use! For example, present-day automobiles and trucks carry electric generators and motors that are equipped with over two thousand different sizes of brushes. If these are the conditions in automotive practice, what must they be in the industrial power industry, with its thousands of different applications of direct- and alternating-current motors and generators?

A ray of hope for relief in this situation is that concrete effort has been made toward the standardization of brushes and brush shunts through the methods of simplified practice, sponsored by the United States Department of Commerce. After a number of conferences standard dimensions have been recommended, which for the most part were those of the Electric Power Club. Although no recommendations have been made as to the present varieties that may be eliminated, a start has been made, which in work of this kind is generally no small accomplishment.

Carrying these recommendations into practice is largely in the hands of the manufacturers of motors

and generators. However, the brush and brush-holder manufacturers and the users have a vital interest in these standards. The manufacturers of brushes and their accessories have been forced to spread their production and investment over a range of sizes and shapes that are legion in number, which increases not only production cost, but also the cost of stocks that must be carried to take care of the trade adequately. These costs must be passed on to the ultimate consumer, whose expense of providing spare parts is increased by the large variety that has to be kept on hand to insure quick service to his equipment.

To a large extent these standards are applicable to new equipment, as the machines that are in operation must be supplied with suitable brushes. For this reason it will be a considerable period before the benefits of the recommended sizes will begin to be manifested. The electrical industry is expanding faster than ever before, and any delay in adopting standards is creating an increasingly worse condition, which must be faced at some future time if adequate means are not taken to correct it now. It is difficult to foresee how far the simplification of brushes can be carried, but a beginning has been made and a permanent organization set up to carry out the work in the future. The degree of success will now depend upon the co-operation of those interested.

Not As Predicted

A NUMBER of times it has been predicted that the use of carbon-filament lamps would soon be abandoned. Apparently something has happened, since their use has been increasing for the last five or six years. Although the use of domestic carbon lamps was on the decline until 1924, their sales have increased since that time. According to a recent report of the National Electric Light Association over 18,500,000 large carbon lamps were sold in this country last year, over eighty-six per cent of which were imported. In 1919 the total sales amounted to about thirteen million, so that notwithstanding all the improvements made in the high-efficiency tungsten lamp since that time, the use of low-efficiency carbon lamps has increased about forty-two per cent.

One of the reasons given for this increase is the lower cost of carbon lamps. For the same amount of light the carbon-filament lamp will consume from two-and-one-half to four times the power that a tungsten-filament lamp will require. If a fifty-watt tungsten lamp has an average life of one thousand hours, it will in this time consume fifty kilowatt-hours which, at eight cents per kilowatt-hour represents a cost of four dollars for power, and the lamp can be purchased for twenty-seven cents. To produce the same amount of light with a carbon-filament lamp will require an additional expenditure for power of from six to twelve dollars. In other words, the saving by using the tungsten lamp equals from twenty-two to forty-four times the cost of the lamp. Evidently, where the cost of the lamp alone is involved, the carbon lamp should not be considered even if given away.

There has been considerable stress placed upon the ability of carbon lamps to withstand rough usage compared to the tungsten type. It must be admitted that the earlier type tungsten lamps were rather fragile, but they have been improved until the average tungsten lamp compares favorably with the carbon lamp in its ability to withstand shocks and vibration. A rough-service type of tungsten lamp has recently been developed that on test has proved far superior to the carbon lamp to withstand shocks and in addition will give over two-and-one-half times as much light for the same power consumption. In many cases rough lamp service is more imaginary than real, since it can be avoided by proper installation methods, so there appears to be small excuse even for using carbon lamps in this service.

Probably a large percentage of the carbon lamps are used in places outside the control of operating and maintenance engineers. But here is a case where, in the application of electricity, a backward step is being taken, and it is well for engineers and others identified with plant operation to check up and see if they are contributing to this waste.

Considerations in High-Speed Oil-Engine Design

AT PRESENT the keen interest in high-speed oil engines has prompted many manufacturers to experiment with high revolutions. The danger that lurks along the wayside is that both purchasers and builders have a tendency to assume that a high-speed engine is merely a light-weight replica of the typical slow-speed unit.

Operating conditions in a stationary power plant do not compare with those to be undergone by high-speed engines when placed on industrial machinery such as shovels and locomotives. The engineer operating the former is more or less skilled and has available the services of a machine shop. Adjustments are promptly made and reliability is not entirely a matter of design. Where, on the other hand, an engine is placed on a shovel, some abuse must be expected. The tendency to load the shovel to its maximum capacity is always in evidence, and a day's run is made up of a succession of overload and no-load periods. The cylinder never reaches that condition of constant temperature stress existing in an engine carrying an industrial load.

The operator in many cases has no proper appreciation of the necessity for adjustment, and deferring action causes maintenance charges to be excessive. Reliability and minimum repair expense, then, must be built into the machine. The high-speed Diesel must be designed for its specific duty, and slow-speed traditions should be thrown to the winds.

Automotive engines early adopted the underhung crankshaft, for the reason that a shaft bedded into the crankcase could not be easily removed. Designers of large engines quite properly prefer the bedded type as permitting a rigid shaft support, and the commodious frame made bearing examination and removal matters of ease. There seems to be a current feeling that high-speed Diesels must have incorporated the bedded shaft. For certain applications acceptance of this demand may prove most disastrous, for the high-speed frame will not permit the easy inspection and adjustment possible if the shaft is underslung.

Differences in lubrication methods must likewise be acknowledged. In large units the problem is to give proper cylinder lubrication, while the high-speed designer finds that his trouble is overlubrication. The throwing of oil from the crankpin due to the higher rotations, so loads the piston-bearing surfaces that some wiper arrangement must be added.

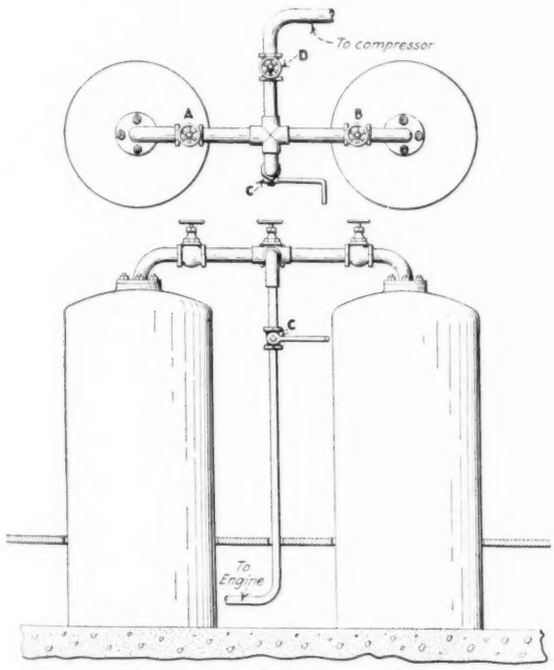
Ideas From Practical Men

Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted

Valve and Cock Arrangement for Compressed-Air Starting Bottles

The valve that permits communication between the compressed-air starting reservoir and a gas- or oil-engine cylinder is often subjected to considerable abuse, because it has to be opened quickly when starting the engine and afterward tightly shut in order to prevent leakage and loss of pressure. Some builders supply specially constructed, quick-opening and closing air starting valves, but generally this important point is overlooked and the use of standard steam valves is a rule rather than an exception. To make matters worse, some engineers apply a lever when handling the latter type and, as a consequence, the thread on the stem is damaged and the valve made inoperative.

An established arrangement with two stop valves *A* and *B* and a quick opening and closing cock is represented in the illustration. In this case two air bottles are provided and either of the stop valves can be gradually opened before the engine is started, the full stream of compressed air being suddenly admitted to the engine by means of the plug cock *C* in order to impart a maximum momentum to the flywheel. Furthermore, interrupting the air supply is easily effected, and after the engine has been in operation for a few minutes the engineer has ample time to close the stop valve without overstraining the disk and stem. A fresh charge of compressed air is admitted through a stop valve *D*, and it is obvious that this valve will reduce the possibility of leakage in the direction of the compressor. The plug cock *C* is provided with a crank and may be placed in a horizontal plane if desired.



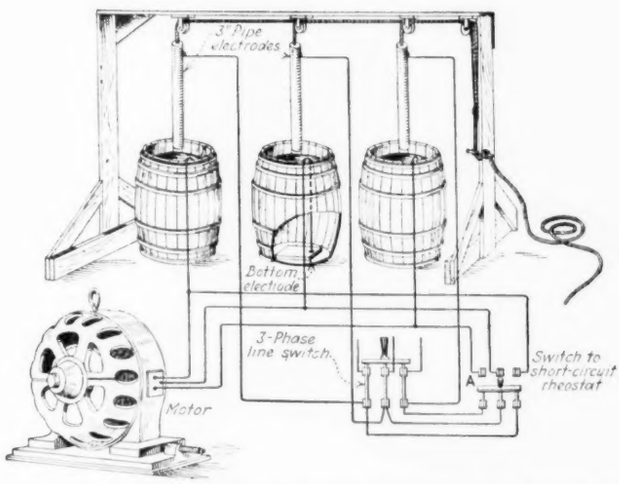
Arrangement of air bottles and connections

W. WIELAND LOS.

Enochede, Holland.

Water Rheostat Used To Start a Three-Phase Motor

A water rheostat can be applied in many ways as an emergency starting device. One of these is shown in the figure. The starting compensator on a large three-phase squirrel-cage motor failed by the transformer coils burning out, and it was necessary to keep the motor in service until new coils could be obtained. This could not be done without some sort of starting device, as the system would not allow starting the motor by connecting it directly to the line. There was also some doubt as to how the motor windings would stand up when connecting them directly to the line at starting, even if the disturbance on the system would not be objectionable.



General arrangement of water rheostat for starting three-phase squirrel-cage motor

To provide a temporary starting device, it was decided to use a water rheostat. Three oil barrels were picked up around the plant and filled with water. A framework was built over these to support the movable electrodes, which consisted of pieces of 3-in. pipe. These electrodes were connected to small ropes carried through pulleys and the three ropes tied together so that the three electrodes could be handled as a unit.

A piece of iron plate was connected to the motor leads and placed in the bottom of the barrels for the stationary electrodes. To insure that all the resistance was cut out of the motor circuit after it was brought up to speed, a switch *A* was connected so that it short-

circuited the water rheostat when closed. A sign was placed on this switch stating that "This switch must be open before starting the motor." If this switch were closed before the line switch was closed, the motor would be connected directly to the line and it was desirable to avoid this happening.

Salt must be added to the water in the barrels to make it a conductor. On a three-phase circuit it is desirable to keep the resistance in the three phases as near balanced as possible, therefore when adding salt, equal quantities should be added to each barrel. The water should be at the same level in each barrel and the electrodes adjusted so that they all immerse an equal distance into the water. The amount of salt can be determined by trial. The motor should start when about 6 in. of the electrodes is in the water. A pint of salt may be added to each barrel and thoroughly dissolved in the water. If the motor does not start when the electrodes have been lowered six inches to a foot in the water, add an equal quantity of salt to each barrel and try starting the motor again.

For motors of 25 hp. capacity or less three water buckets can be used. It is best to use wooden containers, since if metal containers are used, if an electrode should hit the container there would be danger of burning a hole in it. Also if a metal container is used for a considerable period for a rheostat the electrolytic action of the current and the effects of the salt are likely to corrode a metal can or bucket badly.

Cleveland, Ohio. P. W. SAWYER.

District Heating with Exhaust Steam—Why not?

No more does the East River freeze over, no matter how cold the winter, and the same might be said for many another body of water. Back of this fact lies a great waste and a neglected opportunity.

Mr. Hoover and his Department have made substantial progress toward standardization and the utilization of waste in industry, but no one appears to devote much attention to what is perhaps the greatest waste of all—the waste associated with the development of steam power and carried off by the exhaust steam.

Roughly, a great central station will turn into electric energy one-quarter of the heat of its fuel. Of the remaining three-quarters the greater part is lost in the exhaust steam, at the condensers. This loss amounts to about one-half of the total heat of the fuel. There is nothing new in this statement, but our apathy toward these facts needs to be considered.

It is this waste which elevates the temperature of the East River 10 deg. F. or more and prevents the formation of ice, even in the coldest weather. One Brooklyn generating station alone at full load, uses 576 million gallons of river water daily for condensing purposes—more than the combined daily water consumption of the Boroughs of Manhattan and the Bronx. In condensing the exhaust steam of this station, the temperature of the river water employed is raised about 20 deg. F. This and eight other great generating stations located on the East River conspire to moderate our none-too-salubrious winter climate; although this perhaps is not the purpose intended.

The total coal consumed by these nine stations is probably in excess of 25,000 tons daily—involving avoidable daily heat-waste equivalent to, say, 12,000 tons of coal. Now 12,000 tons of coal would take care of the daily fuel requirements of about 200,000 families over a heating season of the seven colder months of the year.

Here is a great opportunity in the public utility field. It is virgin territory. Everywhere, these companies are reaching out for new business in a laudable effort to increase revenues. And yet the utilization of the heat of the exhaust steam for district heating has not been touched, so far as domestic needs are concerned. The domestic consumer pays about three times as much for heat as he does for electric current. It is amazing that this fact has not been properly recognized in the public utility field.

Utilization of exhaust steam for heating is common in industrial plants and in many larger office buildings, hotels and apartments, although there now seems to be a tendency in this latter class to do away with the individual power plant. This involves the purchase of current and, often, of district heating. This tendency is due largely to the high rental value of the space occupied by the power plant and the wages of the operating force.

Possibly half of Manhattan Island is covered by the steam mains of district heating companies. Live steam is supplied; no power is taken from it at the boiler house. It is easy to see a neglected opportunity here, although back of it probably lies the matter of franchises. Nevertheless the conclusion is irresistible that a combination of the central electric station with the district heating plant would be almost ideal. The steam for district heating at 25 or 50 lb. would come from the bleeder-turbines of the central power station. The point is that the power station can utilize only the available energy of the steam; whereas district heating utilizes the entire heat content. Therefore power and heat admirably complement each other. There is nothing new in this idea, and yet the matter continues to be ignored.

Recently fundamental changes in power-plant design and operation have made certain objections to byproduct heating no longer valid. These fundamental changes include the modern high-pressure boiler, employing pressures up to 1,200 lb., in combination with the bleeder-turbine. These are the chief factors in a combined plan for power and heat production.

In connection with domestic heating it would be well to point out that insurance statistics indicate that over half of the fires originate with the heating plant in the cellar. District heating would do away with this vast economic loss and would eventually reduce insurance rates.

Taking into consideration frequent coal strikes involving uncertainty of supply, the nuisance of caring for the household heating plant with its dirt and ashes, the high cost of coal which is often of poor quality, district heating should make as strong an appeal to the householder, as it should to the central station.

Brooklyn, N. Y. ALFRED COCHRAN.

ONE CUBIC FOOT OF WATER at 70 deg. F. weighs 62.3 lb. At 212 deg. the volume of this weight of water will be 1.04 cu.ft., an increase of 4 per cent. If the water is turned into saturated steam at 100 lb. gage pressure, its volume will be 242 cu.ft. At 212 deg. the volume of this weight of saturated steam will be 1,670 cu.ft. and at an absolute pressure of one inch of mercury it will be 41,000 cubic feet.

Comments from Readers

What Is the Best Type of Furnace for Return-Tubular Boiler?

I should like to hear from some of the readers of *Power* who have had experience with hand-fired boilers, what they consider the best design for a furnace burning coal having the following proximate analysis: Moisture, 0.71 per cent; volatile matter, 17.34; fixed carbon, 75.06; ash, 5.84 and sulphur 1.05 per cent; heat value, 14,771 B.t.u. per lb. dry.

The foregoing analysis was furnished by the mine owner. The percentage of moisture given may be right for the coal as mined, but after being stored for three or four months the moisture content will be nearer 3 to 5 per cent. The boiler will be 72 in. in diameter and 19 ft. 6 in. over-all with overhanging front and 3½-in. tubes and carrying 150 lb. gage. The grate will be of the hand-stoker type.

The boiler will be set in battery with another 72-in. boiler and served with a radial-brick stack 98 ft. high above the dead plate. The flue is 3x4 ft. and about 12 ft. in length from the boiler to the stack. The gases will be required to make three right-angle turns between the damper and the chimney.

Under these conditions what should be the height of the boiler above the dead plate? What should the distance be between the bridge wall and the boiler and what per cent of rating should the boiler develop with natural draft and careful firing?

The furnace volume should be liberal, as it is desired at times to force this boiler to the limit (with hand firing); in fact, an opening will be left in the setting so that a small turbo-blower can be installed to give forced draft if desired. The Chicago setting need not be considered or any other type that is designed for smoke abatement, as this boiler is in the country and a little smoke will not be objectionable; however, it is desired to burn the coal efficiently. A recommendation as to the kind of furnace lining that has been known to give good service will also be appreciated.

Rockland, Mass. BURTON W. WHEELER.

Texas University Installs Largest Lignite Stoker Units

Food for thought is contained in the brief paragraph on page 425 of the March 15 issue, announcing that the largest lignite stokers were being constructed for the power plant of the University of Texas. It would seem to be a recognition of the fact that someone was giving serious thought to a natural resource long neglected.

When I was connected with a pulverized-coal company in the Middle West some years ago I was impressed with the extent of lignite deposits in Texas and in the Dakotas, and the apparent lack of interest in making it suitable for wider use. Oil and natural gas were so plentiful and cheap in Texas and Oklahoma that nobody worried about any other fuel, while in the Dakotas the interest seemed to center in attempts to briquet lignite.

One of the chief adverse properties of lignite is its poor weathering character. It slacks rapidly, breaking down almost to a powder and shows a tendency toward heating when in storage. Having a very high moisture content when freshly mined makes it uneconomical and inefficient. Lignite is easily dried down to about 5 per cent moisture content and can be pulverized with a small amount of power. Tests have shown that it is not necessary to pulverize to the fineness required for bituminous coal in order to get satisfactory results. If it is pulverized from 70 to 75 per cent through a 200-mesh screen, it will be fine enough for burning. There is no reason why lignite should not be used with unit pulverizers.

The installation of the stokers in the power plant of the University of Texas should open the way for learning considerable about the commercial use of lignite. If the experiments are successful, we may look for an increase in the development and industrial growth in sections of the country having a plentiful supply. Just as the industrial development in the South has been aided by the widening of a cheaper power supply, we may soon see central stations similar to Valmouth in Colorado, making use of native fuel. W. J. RISLEY, JR.

North Glenside, Pa.

Life of Metallic Packing

I have been much interested in the letters that have appeared in *Power* on the "Life of Metallic Packings." At the plant of the Ice Manufacturing Co., Montreal, Quebec, metallic packing has been in use on an ice machine for the last thirteen years, and this machine has been running day and night. The rod is in first-class condition, the power plant one of the best maintained in this coutry, and absolutely free of ammonia fumes at all times.

This is the best record we have ever heard of, particularly on a service so severe as ammonia.

Montreal, Que., Canada. G. A. FITZGERALD.

At the plant of F. Schenk & Sons Co., Wheeling, W. Va., there are two non-releasing Corliss engines each driving a 100-kw. direct-current generator. The engines are 15x16-in. and operate at 250 r.p.m. The steam pressure is 135 lb. The piston rods on these engines were packed with a metallic packing on May 16, 1909, and are still running perfectly with no apparent wear on either the rods or packing. From all appearances the packings are good for another long period.

The packings have thus been in use 18 years, and the engines have been operated an average of 18 hours daily. A. DOWNING.

Columbus, Ohio.

At the plant of the Pfaulder Co., Rochester, N. Y., a 16x28x30-in. tandem Corliss engine has been in practically continuous operation since July, 1907, and still

has the original sets of metallic rod packing in service. The steam pressure is 125 lb. and the speed of the engine 100 r.p.m. The unit operates from 9 to 12 hours a day.

This gives the rod a travel of about 75,000,000 ft. per year. The piston rod is 2¾ in. in diameter and is in first-class condition and from all indications there is still a lot of service left in the packing. A. S. CHARLES.

Rochester, N. Y.

"Accident Sense" in the Power Plant

Many large industrial firms and utility companies now have organized welfare work and safety-first campaigns in an endeavor to preserve the health and lives of their employees and prevent accidents, but despite this, the various reports of governments and research committees still show a large number of accidents.

The dictionary definition of an accident is given as "anything that happens without foresight or expectation; a befalling; an undesigned, sudden and unexpected event." In the legal and equity sense, which those in the power plant must consider, an accident is defined as "an event happening without the concurrence of the will of the person by whose agency it was caused"; consequently contributory negligence, the real cause of many accidents, does little to reduce the liability no matter how much or how little has been done to avoid accidents.

If we are to do all possible for the prevention of accidents in the power plant, we must perforce study their causes and adopt the various means to counteract and prevent them. But no suggestion is made for dealing with the foolhardy workman who, by his own awkwardness or clumsiness, is always in trouble and, owing to some physical or mental defect lacks entirely what I think is best described as the "accident sense." He turns on valves, puts in switches and starts machinery without a thought for himself or others, and if the results of his actions could be eliminated from statistics, avoidable accidents would be greatly reduced. Two cases of this sort happened recently, which, I think, describe this type accurately.

When making alterations to some of the equipment in our plant, it was necessary to true up the solid coupling on the end of the crankshaft of a high-speed engine. The man detailed for the work was looked upon as a conscientious lathe worker and anything but reckless. When taking the light cut on the outer face of the coupling the cuttings tended to lodge in the bolt holes and the man began flicking these off with the forefinger of the right hand and very soon had about half an inch nipped off the end, which resulted in his laying off for more than a fortnight. The job, not being urgent, had been left over, and on his return he proceeded to finish it, and three hours later, while taking the cut on the inner side of the coupling, a similar piece was removed from the forefinger of the left hand, after which I got another man to finish the job. Many embarrassing calls from the government inspector followed, but no practical suggestions.

In the second case we were overhauling a large engine and the cylinders were to be lifted off by the crane overhead. When all was ready, owing to lack of headroom it was necessary to remove a length of handrail from the platform around the cylinders. Just as the man in charge had removed the nut on the end of the rail, the whistle blew for the mid-day stop, and, dropping the nut anywhere, he hastened down. On his return he proceeded at once up the ladder and, on nearing the top, grasped this rail for assistance. Of course it came away in his hand and both man and rail fell to the floor, the latter in its flight striking a helper and inflicting a nasty gash in his head. The man who fell was badly injured and returned to work only after a long interval to become again the principal in a similar accident almost at once. Both these cases cost the firm a considerable sum, and it was a relief to see the men outside the gates for good. The inspectors, who again visited us, could give no suggestions for preventing such accidents, except prohibiting such persons from going near machinery. The careless workman can often be cured and one experience often does wonders, but the lack of accident "sense," as in the cases given, cannot be cured.

We are told in official reports that many accidents would not have happened if the responsible official or foreman had been on the spot and kept an eye on these helpless persons. Better still, make sure that no workman who has to be left to his own resources around machinery lacks this "sense." F. P. TERRY.

Belfast, Ireland.

Growing with the Plant

A real team-working organization exists when the engineering staff of a power plant represents long years of service. Outsiders view such a staff favorably, and it is not difficult to fill any existing vacancies. Aspiring and foreseeing members of the engineering profession are always attracted to the opening, because of the promised individual growth within the organization and in the engineering work. Instead of being faced with the problem of seeking new engineers from time to time, there is a decidedly contrary situation. Alert, ambitious individuals are always eager to become a part of the organization. The employee problem is a negligible factor in such a plant.

The chief engineer of one large power plant said: "It must not be forgotten that the head of an engineering staff is free to give much of his time and thought to the really important phases of his responsibility when surrounded with steady, dependable men. He is not in that disquietude that makes for inefficiency as is the chief who constantly must be worrying about new assistants. My advice, above all, is to concentrate efforts toward securing men who want to stick and grow with you and the company. The head of the staff, of course, must be ready to do his part to encourage the men to stay."

How has this chief engineer solved his problem? He has contributed steadily toward its solution—because by showing interest in his assistants he has won their reciprocation. A newcomer to the staff will be familiarized with the surroundings and made friendly with his co-workers. Cold strangeness, which so discourages many a new assistant, is therefore dispelled. The new man readily falls in with the conditions and with the other members of the staff.

The chief engineer counsels the reading and studying of certain textbooks and engineering trade papers. These suggestions impress favorably the new member of the staff, and he is convinced that the chief is interested in him. Naturally, he thinks carefully before deciding on a discontinuance of service.

The fact that each man is shown how he can improve himself brings about a development of each member of the staff and the staff as a whole. This promotes a more united and efficient organization.

Every two weeks there is a general get-together, where each member of the staff can contribute ideas, thoughts and suggestions and where the more difficult problems of the power plant are discussed. At the conclusion of the meeting each assistant is better fitted to fulfill his responsibilities. Frequently, the head of the company attends this meeting. When a meeting is arranged for the discussion of important questions, every member of the staff is invited.

Naturally, each assistant enjoys the confidence of the chief engineer, and there is never any aloofness. As a result of this pleasant relationship a smooth working organization is developed. The men are enthusiastic. Naturally, the friendly get-together spirit, inspired and fostered by the chief, assumes a steady growth which benefits the individual, the staff and the power plant.

Brooklyn, N. Y. FRANK V. FAULHABERS.

Economics Versus Salesmanship

In an editorial in *Power* of March 15 under the heading, "Economics Will Give the Final Answer," the discussion of the competition between the central station and the isolated plant is interesting and timely. One of the things about this situation generally misunderstood by business executives and industrial managers is the value the isolated plant has as a competitive factor in rate making for central-station power. In the isolated-plant field the central station is confronted with severe competition. In the desire to dispose of all these plants, central stations have not shown the best business judgment in shutting some of them down. Special rates of former years for special cases quite generally have disappeared, and in the attempt to make standard rates that would be suitable to operate against the better class of isolated plant, many of the central stations have developed rates that are too low.

Much business has been taken on that furnishes an outlet for a large amount of energy, but a considerable portion of such business has not brought in satisfactory revenues per kilowatt of station demand. The result is, the average rate yield in many properties has gone down to a point where profits are probably too low. The political aspect of this situation is not pleasing because the consumers who are enjoying the lowest rates are decidedly in the minority. The mistake has been in placing all isolated plants in the same class. Making rates low enough to shut down the better plants has resulted in too good a bargain for the poorer class of isolated plants. This has furnished good advertising for the central station, but, like any other manufacturing business, if satisfactory profits are to be made, the price of the product must be right. On this basis the central station should shift its main business viewpoint from kilowatt-hours output to dollars income.

Another thing, the central stations have so stressed their size in the minds of the general public that many have gained a wrong conception of the effect that plant size has on economies of power production. This has led not only many business men but engineers as well to proceed on the theory that, of course, purchased power can be obtained at a lower cost from a big plant than such power can be generated in a small plant. The result has been many new installations of central-station power that subsequently have proved disappointing to the purchaser.

A case in mind is a chain of new hotels where the owners installed boiler plants of a type entirely unsuited for the economical production of power. Boilers were as necessary for the operation of the property as kilowatt-hours or house furniture, yet the hotel operators, without unbiased study, were so sure that purchased power was the permanent solution of their problems, that they handicapped the enterprise with faulty boiler plants in such a manner that they now cannot help themselves by generating power without buying new boilers. In any hotel the cost of purchased power is such a serious matter that at least it should fortify itself with a suitable boiler plant for power generation at the outset.

Another case may be cited where a hotel operator who was generating his own power, said it was costing him 5c. per kw.-hr. to produce electricity and he could buy it for 2c. He was asked how many kilowatt-hours his plant was generating, and the reply was, "I do not know and I cannot find out." Yet the manager and his operating engineer both believed that purchased power would save money, and neither one knew how much the power was costing from their own plant.

The amount of guesswork that has gone on in this highly competitive field of the isolated plant versus the central station, has resulted in engineering blunders that have reflected adversely on the whole engineering profession. Probably the faults are about evenly divided between the operating engineer and the central-station sales forces. On the one hand, a powerful sales organization has done some bad engineering at the expense of the purchaser of power. On the other side, good engineering from an operating point of view has suffered terribly from the lack of ability to sell it to the man who pays the bills. In the no man's land in between, architects, posing as experienced engineers, also have made mistakes and plenty of them. The evils of so-called free engineering have contributed, for in many cases the economics have become secondary to merchandising profits in the sale of kilowatt-hours or from equipment badly unsuited to the needs of the particular case.

In the past, in some quarters, it has been deemed highly improper even to question the economic ground on which central-station business has been taken. On the other side of the controversy, there has been the attitude that the isolated plant could win out in any kind of application, which as a matter of course, is not true.

It would appear that the engineering profession will be forced to establish more definite contacts with business executives and do more educational work outside of their own ranks before these matters will be decided to the best interest of industry as a whole.

EGBERT DOUGLAS,
Chicago, Ill. Douglas & Crytser.

Increase in Cylinder Oil Consumption Due to Boiler Compound Entrained in Steam

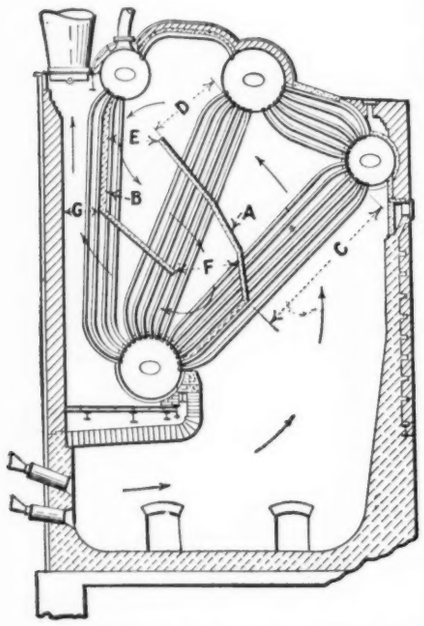
I should like to hear from some reader of *Power* who has experienced trouble with boiler compound carrying over with the steam, as to the percentage of increase necessary in the amount of cylinder oil to lubricate the engine cylinder properly. My theory is that this chemical compound cuts the oil and reduces its lubricating qualities to the extent that considerable more oil must be used. W. E. FOLEY.

Cleveland, Ohio.

New and Improved Equipment

Danks Method of Baffling Water-tube Boilers

To provide for practically direct cross-travel of gases over the tubes on water-tube boilers of the inclined-tube type, the baffle arrangement shown in the illustration has been brought out by A. C. Danks, Cleveland, Ohio. The arrangement provides for an increased area of available heating surface in



Arrangement of baffle to give cross-flow of gases

the first two passes, and also tends to reduce the abruptness of the turns which the gases of combustion make in passing through the boilers, thus tending to improve the draft conditions.

Referring to the illustration, the front baffle *A* is made up of two sections, one section running longitudinally with the tubes in the first bank and the other extending across the tubes in both the first and second banks. The rear baffle *B* consists of a vertical section in the middle of the last bank, and a section cutting the tubes at about right angles. The baffles are arranged so that the net areas, *C*, *D*, *E*, *F*, *G*, gradually decrease in cross-section in relation to the decreased volume of gases, so that the velocity of the gases throughout the boiler remains practically constant.

Another feature of the arrangement is the absence of flat sections which act as soot pockets, all sections of the baffle being readily cleaned by the application of mechanical soot blowers.

The baffle is sold and distributed by the Engineer Co., New York City.

Another Firm Enters the Diesel Field

The Chicago Pneumatic Tool Co. has recently completed the first of the four-stroke-cycle solid-injection Diesels which it is building under a license from the Benz Co., of Germany. As the illustration shows, the engine is of the vertical multi-cylinder type and ranges in capacity from 80 to 240 hp. at 327 r.p.m., depending upon the number and dimensions of the cylinders.

The crankshaft is bedded in the cast-iron sub-base upon which rests the frame carrying the separate cylinders. The camshaft is placed along the frame at a level with the cylinder bases. The several valves are operated from these cams by reach rods and rocker arms.

The cylinder head is of the plain Diesel design, while the trunk piston follows general practice.

A separate fuel pump is used for each cylinder. The Benz type of injection nozzle or cup is used.

Recently, an Oklahoma oil company desired to obtain 40 engine-driven compressors, and the Benz engine was modified by replacing the fuel-injection system with a gas-mixing valve, magneto, etc., so that it could be operated with natural gas. The compressor cylinder replaced one of the working cylinders.

The advantage of this is that whenever the gas flow from the wells becomes insufficient, the engines can be changed.

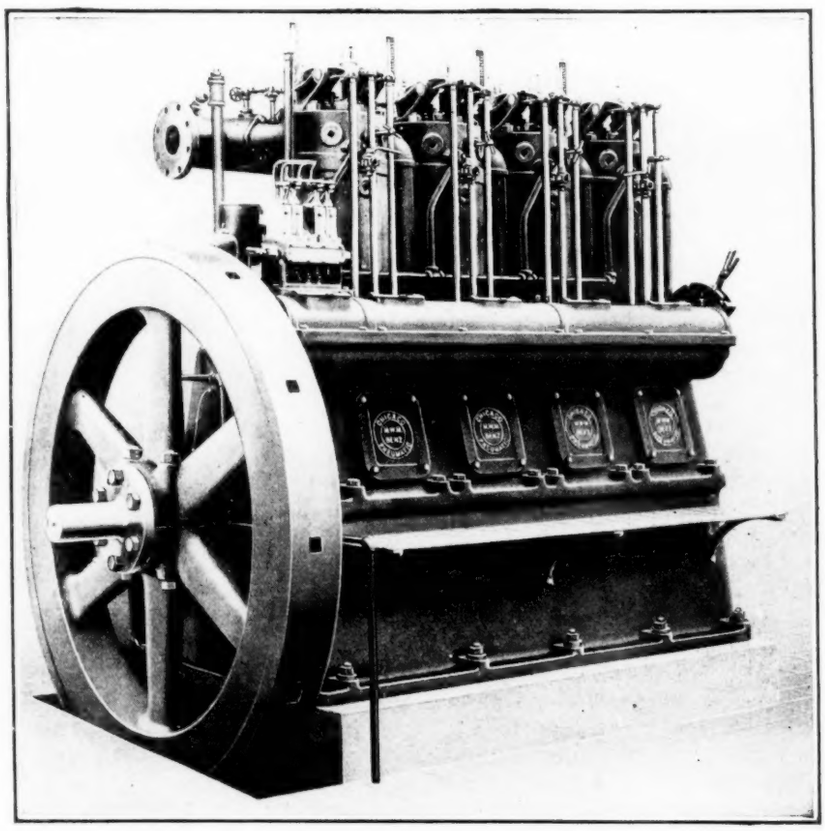
It is the intention to build the Diesel engines on a production basis, and the design is such that a wide range of engine capacities can be obtained with a given dimensioned cylinder.

The engine shown in the illustration is for stationary service, but the attachment of a simple cam-shifting device will permit the Benz engine to be made reversible.

Cochrane Flow Rate Controller

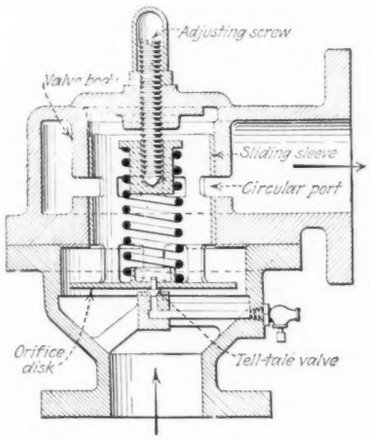
Although developed primarily to insure against overloading of pressure filters and to regulate the flow when backwashing, the constant flow rate controller developed by the Cochrane Corp., Philadelphia, Pa., illustrated herewith, is adaptable to other uses where a constant flow of water, steam, air or other fluid is required.

As may be seen from the drawing, the controller contains only one mov-



Benz Diesel as built by the Chicago Pneumatic Tool Co.

ing part. The difference in pressure set up by flow past a disk in the entrance chamber exerts force upon a sliding sleeve valve in opposition to a spring. When the rate of flow is greater than the rate for which the spring tension has been adjusted, the valve will be shifted toward the closed position, and vice versa, coming to rest in a position such that the area through the discharge ports is just sufficient, with the pressure then existing in the supply line, to discharge the predetermined quantity of fluid. In order to supply a visible indication that fluid is being passed at the desired rate, a small telltale valve is opened as soon as the disk and valve are moved in opposition to the spring. This small valve is connected to a pet-cock that can be opened by the operator. The controller is made in standard pipe sizes of 1¼ to 14 inches.



Cross-section of controller

Vibration Indicator

A simple vibration indicator for determining the direction and the amplitude of vibrations is being built by Lehmann & Michels, Hamburg, Germany.

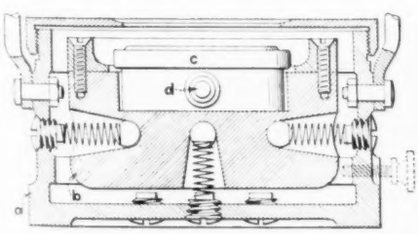


Fig. 1—Vibrator mechanism

The instrument, Fig. 1, consists of a housing *a*, within which the mass *b* is suspended by springs to give it a free movement, as shown in Fig. 1. The measuring dial *c* attached to the mass, is connected with the housing *a* by the rod *d*, which causes the vibration of the housing to be transmitted to *c* and will show the maximum amplitude when the direction of the vibration corresponds with that of the rod *d*.

In the application of the instrument the case is turned until the point of maximum pointer of the vibration is reached. The arrows on the top of the case, Fig. 2, will indicate the direction of the vibration and the dial reading will show the amplitude. With the aid of a stopwatch, the number of oscillations in any desired unit of time can be easily determined.

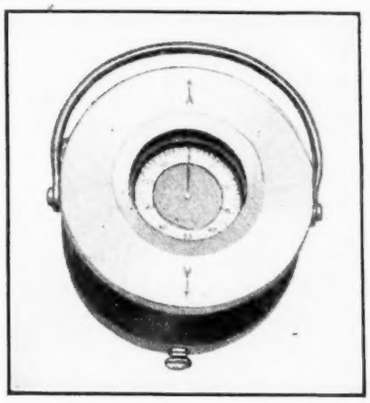
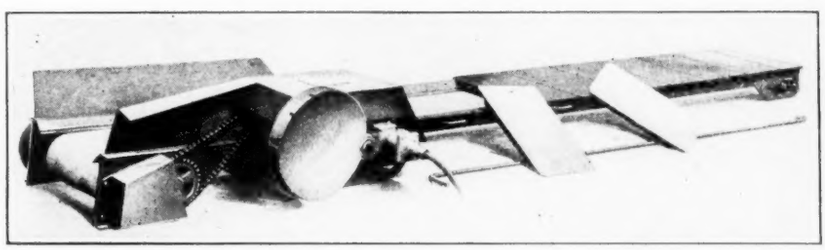


Fig. 2—Case and dial

Jeffrey "X-Track-Tor" Portable Unit

To facilitate the unloading of coal, coke, sand and other materials from hopper-bottomed cars without the use of a pit or trestle, the portable conveyor known as the X-Track-Tor, illustrated herewith, has been brought out by the Jeffrey Manufacturing Co., Columbus, Ohio.



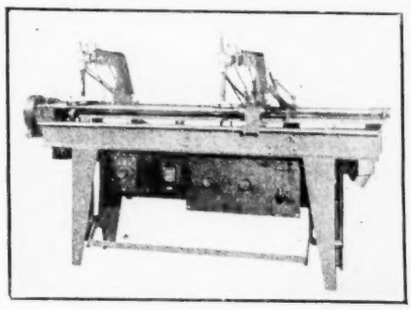
Portable flight conveyor with rubber covered belt

In the conveyor the usual double strand of chain and scraper flights has been replaced by a 16-in. three-ply rubber-covered belt, and this has reduced the space required for the conveyor to a minimum. In operation the flow of the material from the car is regulated by the hopper opening and by removable cover plates over the belt, as shown in the illustration. As the material flows out of the car, the cover plates are removed, permitting the conveyor to receive the material from the farthest side of the car hopper. When unloading from a car having several hoppers, the conveyor is readily moved along the rails to the next hopper position.

The conveyor is built with either a gasoline engine or an electric motor. In either case the driving unit is made detachable for convenience in handling. The complete unit is 13 ft. long and 20 in. wide over all and weighs approximately 600 pounds.

Lincoln Welding Machine Operates With Carbon Arc Process

The butt welding machine illustrated has been recently introduced by the Lincoln Electric Co., Cleveland, Ohio, as a further development of the machine-driven carbon arc to the problems of welding. The arc welder is not an alternative method of doing butt welding, but has been developed to handle a class of welding that cannot be done satisfactorily with the resistance welder. As an instance of this, a plug may be welded into the end of a tube with the arc butt welder, but the job would be practically impossible with a resistance butt welder.



Carbon-arc butt-weld machine

The machine illustrated welds both ends of the tube at once by the use of the two automatic heads. A similar instance of applicability is that of welding a small-diameter round bar to a large-diameter bar. The welding heat is applied to the joint by the carbon arc, and the bars are revolved to distribute the heat uniformly. Pressure is applied to squeeze out the slag and complete fusion.

Walworth Class AA Steel Valves

The Walworth Co., Boston, Mass., recently announced a new line of steel valves for service under high-pressure and high-temperature conditions.

Valves in this new line are now available for working pressures of 400, 600, 900 and 1,350 lb. at 750 deg. temperature. The valves are made of electric cast steel and are trimmed with Sigmalloy No. 351, this being the name applied to special trims used by this company in its high-pressure valves and fittings. Valves designed for service at 1,000 deg. temperature are included in the new line.

New Developments in Foreign Waterwheel Practice

ONE of the obvious results of interconnection and development of high-voltage distribution systems lies in making many low-head small capacity water-power projects economically feasible for development. It has only been in the last few years that such interconnection has made any appreciable progress in foreign countries, and the corresponding development of small water powers has led foreign turbine manufacturers to devote considerable attention to the many new problems incident thereto.

The following abstract[1] of an article recently published in the *Schweizerische Bauzeitung* by Robert Dubs, chief engineer, Escher Wyss Co., Zurich, Switzerland, describes some of the activities of his company in developing a new type of high-speed runner and also gives some interesting applications.

The necessity of observing strict economy in the development of small projects has led to the adoption of higher velocities in intakes and outlets to permit the use of smaller water passages, and equipment costs are being reduced by increasing the speed of the units. To meet these objectives without sacrifice of efficiency, extensive experimental work has been carried on in the company's testing flume, which is described in the first part of this article.

The increase in specific speed, N_s of a particular runner can be obtained by reducing its diameter or, to a very slight extend, by reducing friction losses on the surfaces in contact with the water.

Fig. 1—Propeller-type runner with 6 blades

The former measure results in greater velocities at the entrance to the draft tube, which means a consequent greater loss of energy at the wheel itself. To regain this energy, the draft tube must be designed to convert it from velocity to pressure energy, and since high-speed propeller and Kaplan turbines operate so as to leave from 30 to 50 per cent of the total available energy in the water as it enters the draft tube, it is obvious that the draft tube is becoming of still greater importance than it is with the normal speed Francis turbine. In fact, there is a tendency now to regard the draft tube as an integral part of the turbine.

It has long been recognized by hydraulic engineers who have studied the action of water in a draft tube, that there is a so-called indeterminable component of motion in the water, which causes considerably greater hydraulic losses than do the determinate components, and which may also readily cause labile conditions in the water column.

Furthermore, since the allowable pressures on the under side of the runner are dependent on absolute conditions (atmospheric pressure), and not upon relative, as is the case in the distributor and the inlet side of the runner, the importance of the draft tube is again emphasized. Particular attention is called to this point to show that the present-day type of draft-tube design is based on an entirely different consideration than was involved with lower-speed installations.

Tests Made on Wheels

A large variety of wheels, all of the same diameter, were tested in the company's testing flume. Later, the most favorably performing runners were studied under different combinations of draft tubes and open flumes as well as spiral casings. Runners of four, six and eight blades gave the most satisfactory results, these runners being of the general type shown in Fig. 1, which has 6 blades. They are of the propeller type with adjacent blades shown as slightly overlapping when viewed in plan.

The test runners were all of the same diameter (23.6 in) and were tested according to usual standard laboratory methods with identical inlet arrangements. Fig. 4, shows the resulting performance curves reduced to standard conditions. The sharpness of the curves makes it evident that these runners are in general only adaptable where the variation of discharge is small or where it is feasible to install several units to fit best the fluctuations imposed by the conditions of the load.

[1]Abstract and translation made by Adolph J. Ackerman.

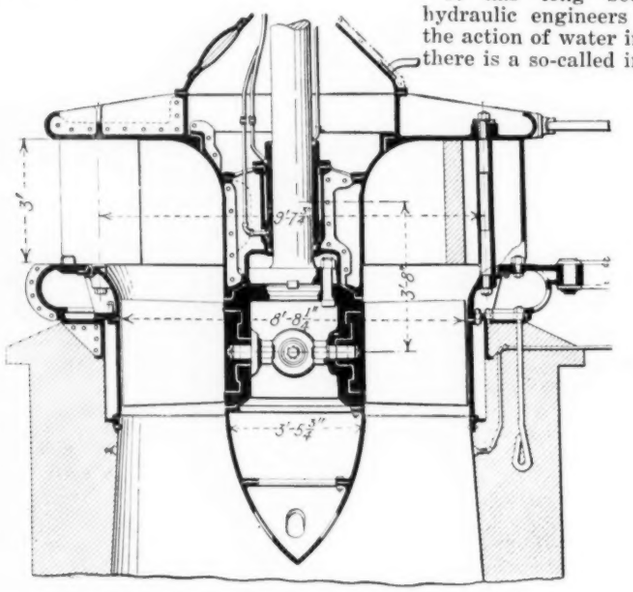


Fig. 2—Propeller-type unit rated at 3,450 hp. under a 30-ft. head

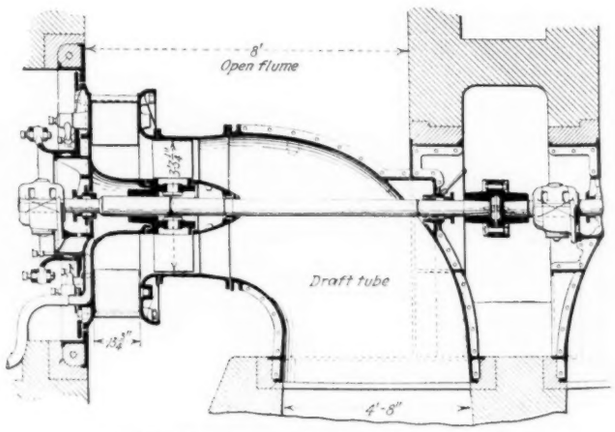


Fig. 3—One of two horizontal-type units mounted on the same shaft

Each of the wheels and setting, represented by curves *A*, *B* and *D*, reached a maximum efficiency of 90 per cent, the one with four blades covering a range of specific speed from 87.5 to 94.3, the one with six blades $N_s = 128$ to 144, and the one with eight blades $N_s = 103$ to 116. Although the six-bladed wheel gave certain more favorable characteristics, the other two are better suited for small or large diameters, and in the majority of the subsequent actual installations the four-bladed runner was chosen.

To avoid misunderstanding, it should be mentioned that the foregoing range of specific speeds was obtained with the same runner provided with either four, six or eight blades of an identical type, and in one and the same flume and conical draft tube setting with the exception for curve C, which is for an elbow tube.

Installations Made

Up to the present time the company has installed twenty-one turbines of this type in various parts of the world. The smallest runner delivers 2.96 hp. when discharging 3.42 cu.ft.-sec. under a head of 10.2 ft. and operates at 1,000 r.p.m. The largest one delivers 4,300 hp. under a head of 33.8 ft., and runs at 166.6 revolutions per minute.

A propeller turbine rated at 3,450 hp. at 180 r.p.m., under a head of 30 ft., with $N_s = 150$, discharges into a draft tube, the design of which is based on a combination of trumpet-shaped vertical passage (originally suggested by Dr. F. Prasil, of Zurich) extending into a horizontal draft-tube chamber. This design has proved satisfactory in connection with an open flume setting, and

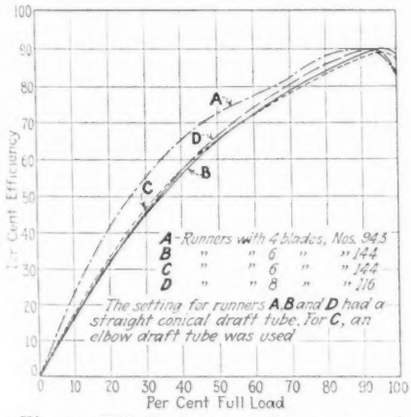

Per Cent Efficiency
Per Cent Full Load
A
D
C
B
A-Runners with 4 blades, Nos. 94.5
B " " 6 " " 144
C " " 6 " " 144
D " " 8 " " 116
The setting for runners A, B and D had a straight conical draft tube. For C, an elbow draft tube was used

Fig. 4—Efficiency curve for 4-, 6- and 8-blade runners

has effected a stable condition of flow at all points in the water column. This point is given emphasis because recent experiences have shown that the modern high-speed turbine is easily subject to labile conditions of flow which not only impair the efficiency of the runner, but also add to the difficulty of obtaining satisfactory speed regulation.

The presence of such lability at a particular spot on the runner usually leads to corrosion. To avoid such pitting, it is of first importance to prevent at all points in the water column the formation of such a pressure as would lead to vaporization at the corresponding temperature of the water. Since, as has already been mentioned, the residual kinetic energy in the water at the discharge side of the runner is considerably greater for propeller turbines than in the case with Francis turbines, it is necessary to arrange the setting of the former type with a lower static suction head in order to reduce the possibilities of pitting.

Fig. 2 shows a cross-section through the 3,450-hp. turbine and brings out several interesting details of construction, as, for example, the method of

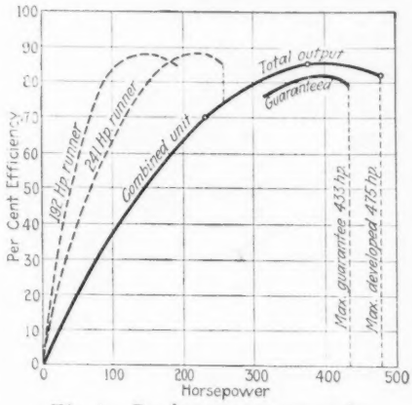


Fig. 5—Performance curves for the unit Fig. 3

attaching the blades to the hub to permit replacement, and the arrangement of the regulating ring which at the same time acts as part of the water passage. The upper cover plate is supported by steel columns which also act as shafts about which the wicket gates pivot. Lateral support for the cover plate is obtained through three or four struts which extend into the adjacent concrete walls. This turbine has given satisfactory results during the last two years and has met all guarantees.

Double-Runner Unit

Fig. 3 shows one of two propeller turbines in a horizontal setting, which were delivered in 1924. They operate under an average head of 17.2 ft., under which one runner is designed for 124 and the other for 158 cu.ft.-sec. The corresponding ratings of the runners are 192 and 241 hp. Since both runners are mounted on a common shaft, both operate at the same speed, 300 r.p.m. The maximum specific speed of the former unit is 118, and the second, 132. The turbine shaft is direct connected to an alternator of standard frequency.

This installation occurs on a flashy river, and it was important to utilize economically even the smallest discharges. To attain this objective, the specific speed of the two runners was chosen as low as possible, and by setting each runner in a separate intake it is possible to operate each one separately as well as both together. Both turbines are arranged in open flume settings and the discharge is carried through elbow-type draft tubes. The performance test results of this unit are shown in Fig. 5. The dotted curves in this figure are approximate, as they were inserted by the translator to show the probable over-all operating range of this unit.

One of the latest installations is the 10-in. diameter propeller turbine, which was delivered in 1925. This unit operates under a head of 19.7 ft. and delivers 74 hp. at the high speed of 750 r.p.m. The specific speed of this runner is 155. The turbine is direct connected to an alternator and is automatically regulated for constant speed.

Sir Charles A. Parsons Talks on Condenser Tube Erosion*

The Hon. Sir Charles A. Parsons, in a paper read before the Institution of Naval Architects in London on April 6, 1927, discussed an experimental study of the erosion of surface condenser tubes.

He remarked that efforts to combat erosion by imposing a counter electromotive force or by protective coatings within the tubes have not been effective. In a few cases more expensive metals have been substituted for brass, and bell-shaped entrance ferrules have been used for some years in an effort to secure smoother water flow at the entrance end of the tube, on the theory that the action is due to oxygen released from the water in eddies surrounding the vena contracta set up by a sharp entrance. In most cases failure has been from erosion or corrosion on the water side, and the action seems to be greater at the entrance end of the tube. These facts suggest that the cause may be hydro-dynamic rather than chemical or electrolytic. The experiments described seem to indicate that tube erosion is confined to regions of turbulence in the water-box.

Small condenser models were made, using a few tubes, with glass water-boxes and, in some cases, glass tubes.

Experiments were undertaken to throw light on actual conditions and to investigate the possibility that the pitting of condenser tubes may in reality be due to water-hammer of collapsing vortices, known to be a potent cause of erosion of screw propellers and of the runners of centrifugal pumps and hydraulic turbines.

It was observed that vortices produced in the water-box were drawn into the adjacent tubes, and that these vortices moved about more or less erratically, but within regions with fairly definite boundaries. Flow through individual tubes varied suddenly in correspondence with the vortex action.

While final conclusions are not yet possible, the experiments seem to lead toward the view that one of the chief causes of the erosion of condenser tubes may lie in the turbulent motion of water in the water-box of the condenser. This could be mitigated by enlarging the inlet passages so as to reduce the water velocity as much as possible before it enters the box, or it might be entirely corrected by arranging in the water-box a grid of suitable mesh with passages of depth somewhat greater than their width. Grids of this kind have been tried in experimental apparatus, and even with violent turbulence in the water-box, flow through the tubes is perfectly steady, and no vortex motion is discernible.

*Abstracted from a fully illustrated article in *Engineering* (London) for April 8, 1927.

Cause of Dangerous Boiler Deterioration

By C. E. STROMEYER
Chief Engineer, Manchester Steam Users' Association

THE following list of objects in the museum, and of related subjects was originally compiled in connection with a lecture delivered to the inspection staff of the Association. The cases dealt with are in no sense average happenings, but extremes, and only likely to occur owing to unforeseen coincidences.

Corrosion

Smooth or uniform corrosion must be classified as dangerous, because experienced eyes are likely to overlook it and it does not present itself in practice with sufficient frequency to allow of much experience being gained about it. This form of wasting removes the substance and leaves a misleading form. In some cases the corrosion has removed about two-thirds of the plate thickness and an equal amount from the rivet heads and from the edge of the plate. The corners of the lap have remained sharp, but the hollow corners of the lap and of the rivet heads have experienced a partial protection and are rounded. This rounding of sharp hollow corners is a distinctive feature of this form of corrosion.

Uniform external wasting of steel fireboxes is generally due to moisture, which settles uniformly on the plates whenever the boiler is cooled. A small firebox cut in half shows that this corrosion on the fire side may extend over large areas. This was a very deceptive case, for even the nuts of the screw stays had retained their hexagonal shape, all their edges were sharp, and the gradual rounding off of the plate under these nuts could easily have been mistaken for washers. Copper firebox plates are subject to the same attack on the fire side, the corroding agents being the sulphur in the fuel.

Sulphur dioxide does not attack cold steel, but when, owing to scale or deposit, part of a furnace becomes overheated, it is readily attacked by the gas. In one case, owing to the sediment settling on the crown of a furnace close to the furnace ring, this part became overheated and the sulphurous gases ate through the metal in a short time.

Corrosion Due to Sulphuric Acid

A curious case of uniform corrosion of a shell plate in the side flues of a Lancashire boiler, due to sulphuric acid, was recently discovered. The inspector's attention was drawn to it by the hammer test, and by his noticing that under the sooty surface in the flue there was a whitish scale of considerable thickness. On drilling the plate it was found to be uniformly reduced to one-third of its original thickness. The whitish substance was found to be sulphate of iron.

It is surmised that a catalytic agent, in this case red oxide, had converted the sulphurous acid of the waste gases into sulphuric acid, to which, during periods of idleness and cold, moisture had been added, and the combination then attacked the steel. During working periods the sulphate of iron would, by calcining, become a spongy white scale, which would absorb more acid, and year after year the corrosion process would be repeated. It has been found that the whitish scale noticeable on some water tubes of boilers is sulphate of iron. This indicates that this corrosion process is always active, but evidently it is not serious.

AN ABSTRACT of the 1926 report of the Manchester Steam Users' Association of London, England, as presented to the association's executive committee.

Prominence is given to uniform wasting, which is the most misleading and dangerous corrosion to be met with in boilers, and has been the cause of many disastrous explosions.

The subject of incrustation is dealt with in an interesting manner and the cause of the formation of scale is explained fully.

Several comments throw light on the causes of failures of apparently sound plates, prominence being given to the possibility of caustic embrittlement.

Corrosion in Hidden Places

Several cases of wasting have been observed where the process had been progressing steadily without detection, because the localities were hidden, either by boiler coverings or by firebrick. There are, as a rule, outside indications of this form of corrosion, and dampness, due either to ground water or leakages from above, should always be suspected of doing harm. It is a good practice to have occasional bricks removed out of boiler seatings and boiler tops and sides uncovered. If discovered in time, external wasting is not serious, for it is slow, and it has to reduce the thickness of the plate to a smaller percentage than that of the riveted joint before a reduction of pressure need be considered.

The museum contains a furnace ring that collapsed owing to uniform wasting. The true cause of this wasting was never revealed, but it is believed that it was caused by thermo-electric currents rather than chemical causes. Had the uniform corrosion been due to chemical causes, then the furnace flanges would have been attacked, but they have retained their original thickness. Whenever there is a flow of heat in a conductor—and a furnace plate is a conductor—there is a tendency for a flow of electricity in the same direction. There will, therefore, always be a difference of electric potential on either side of a furnace plate, and if a circuit can be established from one side of the plate through the water and back through another part of the boiler to the waste gases, and thence to the starting point, weak but uniform corrosion is likely to occur. It is possible that the return current passed into the flanges and actually protected them while the adjoining plates were being wasted owing to the fact that no temperature gradient existed in the flanges.

Corrosion Associated with Strains

Examining the side plates of a Lancashire boiler furnace showed a local corrosive condition. The crossbar, which supports the brick bridge and the ends of the fire bars, was not resting on angle brackets, as is usual, but was resting directly on the furnace sides, and, owing to slight panting movements of the furnace sides, this bar must have produced very severe drum tension stresses on the water sides of the plate. It is generally assumed that this form of corrosion is due to the peeling off of rust due to straining; but this explanation is in conflict with that offered for pitting.

There is a strong presumption in favor of the view that some forms of corrosion are due to certain strains having the power of making steel susceptible to corrosion attack. When steel is stressed beyond its elastic limits, so-called slip bands in the grains are noticeable under the microscope. This illustrates another possible form of attack. They appear to be inclined 45 deg. to the line of direct stress; at least the angles of the surface trace of these bands are never less than 45 deg., and a large number are nearly normal to the line of stress, and if they favor corrosion, one should expect lines of corrosion to form which are normal to the line of stress. This is of interest as bearing on the recently discovered property of mild steel of creeping under tension stress if exposed to high temperatures.

Grooving Due to Fatigue

It has been suggested that the grooving that sometimes occurs in dished end plates may be due in part to static strains, but the general opinion still is that these grooves and cracks are due to fatigue, in and out bendings occurring each time the boiler is laid off, but that these changes are rather too

few to produce cracks. Cracks, however, can be obviated by corrugating about 15 ft. of the flues.

Pitting

Pitting has given rise to many speculations as to its cause, yet pitting in itself is not of real danger. The remedy consists in the addition of tannic compounds to the feed water or in deaërating it. Where deaëration is practiced, pitting does not occur. Pitting occurs only in the presence of air dissolved in the water, and its occurrence is most frequent with waters containing both carbonate and chloride of soda.

Very severe or rapid and localized pitting also occurs in feed pipes or wherever water circulation is sluggish, and is due, apparently, to the occluded air in the water being abstracted by the spongy mounds of rust which are built up out of pit holes. Economizer tubes are subject to pitting due to the water in the pipes being very sluggish and incapable of carrying away air bubbles which might attach themselves to rusty spots.

Graphitic Corrosion of Cast Iron

Graphite corrosion always heats up on exposure to air, and on such occasions unquestionably undergoes a chemical change. The layer that is in immediate contact with the as yet unattacked cast iron is yellowish in patches. The graphitic substance itself looks like graphite, but on exposure to air it becomes about as hard as slate.

Cast-iron feed pipes and feed valves are liable to graphitic corrosion and had better not be fitted to boilers. Some economizer pipes have shown this graphitic deposit. Judging by illustrations in some of the Board of Trade reports on economizer explosions, longitudinal graphitic corrosion has been the cause of some explosions. It, however, is not a common defect.

Steam Space Corrosion

Steam space corrosion is, as a rule of a uniform nature, loose flakes of rust forming in the steam side of the plates and falling off. This form of corrosion is found on parts of plates of steam spaces of boilers that are exposed to the heat of waste gases. It is not of the same nature as the corrosion in superheated pipes, where the steam is doubtless quite dry, and it may therefore be taken for granted that this form of corrosion occurs only in the presence of saturated steam.

It appears most likely related to the corrosion that occurs in steam turbines, in the regions where the steam has lost its superheat. If so, then this form of corrosion is not associated with strain. However, since the discovery has been made that steel creeps if overheated, the possibility of this form of corrosion being associated with creep or heat straining should not be overlooked. The corrosion that sometimes occurs in steam pipes may be of the same nature, but is, as a rule, localized, being affected by the flow of the steam around irregularities.

Incrustation

There are in the museum several specimens of incrustation of economizer pipes thickly coated internally and even choked with scale. The slowness of the motion of the water in these pipes and the slowness of the heating process to which these pipes are subjected, cause much scale to be deposited here to the benefit of the boiler. But this procedure for keeping scale out of a boiler is rather costly, for now it has to be removed by boring out the tubes.

Ordinary boiler scale is of little interest when removed from its location, and this is especially the case with regard to sediment, or rather precipitate, which, as long as it is loose and carried along by the water, does no harm.

When water containing scale-forming matter comes in contact with a heating surface, which imparts sufficient heat to the water to cause a part to evaporate—formation of bubbles—the scale-forming matter in the water that is actually evaporated is deposited on the heating surface, and as a rule it remains there, for it will not dissolve in the surrounding water, because it also is on the point of parting with its salts. If the circulation is violent, as in water tubes, much of the deposit does get washed away before it is cemented to the heating surface; but if the circulation is very slow, there is sometimes sufficient time for the growth of crystals and the resulting scale is of a very hard nature.

Preventing Scale Formation

Seeing that both carbonate and sulphate of lime are less soluble in hot than in cold water, an obvious method of preventing the formation of scale is to bring the feed water, if rich in minerals, into contact with either steam or hot water, whereupon these scale-forming salts are precipitated and float about in the water. It is therefore now an almost universal practice to place the feed inlet pipe above the boiler water level, and sometimes the feed is discharged into troughs, in the steam space, where practically all the mineral matter is precipitated. A further advantage of heating the incoming feed in the steam space is that it there parts with a large proportion of its occluded air, which then has no chance of settling on heating surfaces and corroding them.

Boiler compounds — chemicals intended to precipitate the scale-forming constituents of boiler waters—effect little more than what can be attained by heat, except that some chemicals tend to loosen old scale; but the boiler sediment produced by compounds remains in the boilers, which is not the case where water softeners are used.

When water softeners are used, scale-forming matter is, or should be, almost entirely removed from the feed, provided the depositing and filtering arrangements are in order. If not in order, then the expensive plant might have been dispensed with and boiler compounds used.

No matter whether ordinary boiler compounds are used or water softeners, the soluble chemicals thus introduced remain in the boiler water and gradually increase its density until a point is reached when the salts separate out. This point is much below saturation. When water containing soluble salts passes over a hot plate, that film of water that is nearest the plate flashes into steam and leaves its salts behind. If the heat transmission has been temporarily checked, the next volume of water may re-dissolve the adhering salt but if the heat transmission is very intense, salt from the next volume of water is added to the first lot, and a scale of soluble salts is built up which acts like a scale of insoluble salts in causing overheating. But small changes in the firing conditions, or a temporary checking of the steam demand and, therefore, of the generation of steam bubbles, allows the now comparatively quiet water to re-dissolve the salts. Even if this salt scale should cause a tube burst, it will have been redissolved before the boiler is cool enough for internal examination and the cause of the trouble has disappeared. This should account for many otherwise inexplicable failures. They do not differ from failures due to scale, except that there is never any scale to be seen after the failure.

Removing Temporary Hardness

Temporary hardness can be removed without introducing soluble salts, and barium salts have the advantage of removing both temporary and permanent hardness without adding soluble salts to the water and increasing the density. Soda, either ordinary or caustic, should never be used for the removal of temporary hardness, not only because it is expensive, but because it accumulates in the boiler, and in addition to increasing the density it also makes the plates brittle.

Important research work has been carried out by the Association, which necessitated the construction of numerous special testing machines. One of the most valuable studies is the utilization of the Board of Trade Reports on boiler explosions. The association carefully sorts them for references and looks upon each as if it were a costly experiment from which the maximum amount of information is extracted.

Control of Electric Power Companies

The Federal Trade Commission has issued the following statement in regard to its investigation of the control of electric power companies:

"On Feb. 1, 1927, a report entitled 'Control of Electric Power Companies' was submitted to the Senate in partial response to Senate Resolution 329, 68th Congress, 2nd Session. This report dealt primarily with the organization, control and ownership of commercial electric power companies. The commission has in preparation a further report on the supply of electric power machinery and equipment and on competitive conditions in the entire power field. The field work on the latter phase of the inquiry has been practically completed and the entire report is well advanced in the course of preparation.

"The Senate resolution directed the commission to investigate and report to what extent the General Electric Company directly or indirectly, through stockholders or otherwise, controlled the generation and transmission of electric power, and how the said control was acquired and maintained."

News in the Field of Power

Newcomen Celebration Marks Opening of Museum

Simultaneously with the meeting of the parent society in London, the third annual dinner and meeting of the American members of the Newcomen Society was held at the Engineers Club, New York, last Wednesday evening, April 20. It was also the occasion of the official opening of the Museum of Peaceful Arts to which the members adjointed after the dinner.

At the dinner, Fred R. Low told of the first steam engine installed in the United States by Joseph Hornblower near Belleville, New Jersey, in 1755, and Guy Hubbard related the achievements of Thomas Blanchard, an early American inventor, who brought out the gun-stock turning lathe and experimented with steam navigation on the upper Connecticut River.

Doctor Kunz, on behalf of the Museum, greeted the members of the Society and displayed the exhibits, which included Dr. David E. Smith's lifetime collection of mathematical and astronomical instruments, weights, etc.; also a number of Ericsson models, gages presented by Henry Ford, and a piece of the original Benjamin Franklin lightning rod from St. Paul's Cathedral, London.

A paper discussed at both the London and the New York meetings, by Ferdinand Aachard and Laurant Seguin substantiated the priority of the invention of the tubular boiler in 1827 by Mark Seguin. In the discussion of the paper Commander Turnbull reported that John Stevens had patented a fire and water-tube boiler in this country in 1781.

L. F. Loree also spoke of the importance of museums as educational influences, and discoursed on the evaluation of inventors.

Engineers Will Visit West Point May 12

A special trip to West Point is being planned May 12 for members and officers of the engineering societies under the auspices of the Associated Business Papers, American Chemical Society, American Engineering Council, American Electrochemical Society, American Institute of Electrical Engineers, American Institute of Chemical Engineers, American Institute of Mining and Metalurgical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, Army Ordnance Association, and Society of Automotive Engineers.

The "Alexander Hamilton," of the Hudson River Day Line, has been chartered for the trip. On reaching West Point the party becomes the guests of Brig.-Gen. M. B. Stewart, Superintendent of the Academy. A close survey of the operation of our National Military Academy will be permitted, and there will be special drills by the cadets followed by an evening parade in full-dress uniform. It is planned to leave the West 42nd Street pier at 10 a.m., returning there at about 10 in the evening.

Diesel Fuel Supply Ample for Future, A.S.M.E. Told

Adequate Diesel fuel for the future is beyond question, according to Gordon H. Michler, of the Standard Oil Company of New Jersey, who spoke on "The Future Supply of Suitable Fuels for Oil Engines," before the Metropolitan Section of the American Society of Mechanical Engineers at the Oil Power Week meeting of that organization, April 19.

The general adoption of high-compression automotive engines will, according Mr. Michler, decrease the consumption of gasoline and lessen the necessity of fuel cracking. In the discussion it was pointed out that the real competition of oil engines for a fuel supply is the household heating burner, and that engine manufacturers must alter their engines to permit the use of boiler oil.

Subway Fires Cripple N. Y. Edison Service

Fires of unknown origin which broke out during the late afternoon of April 17 and the morning of the following day crippled from a portion of one to two days the industrial activity of one of New York City's busiest sections, that from Thirty-sixth Street to Fortieth Street in the neighborhood of Eighth Avenue, when the New York Edison Co.'s electric light and power service was temporarily put out of commission.

Owing to the construction of the Eighth Avenue subway the company's cables were suspended in a temporary position awaiting completion of the cable ducts for the permanent installation. The flames from the first fire, which broke out Sunday afternoon, destroyed the cable insullation, thus causing a short-circuit. The current was cut off immediately by the tripping of the protective devices in the Thirty-sixth Street subway station.

The fire, with the resulting short-circuit, caused the destruction of 71 feeders cables, varying in size from 1,000,000 to 2,500,000 circ.mils., according to the utility company. More than one-half of the service in the section was restored after a day's labor of the emergency department, and full service within 48 hours.

This shutoff of service is considered the worst failure to deliver power in the history of the New York Edison Co.

Refractories Institute Plans Spring Meeting

The American Refractories Institute will hold its annual spring meeting at the Hotel Traymore, Atlantic City, N. J., Wednesday, May 18. A golf tournament will be held the following day.

All engineers and manufacturers interested in the manufacture or use of refractory materials are invited to attend the meeting. For the last half year, the Institute points out in its announcement, the Refractories Fellowship has been conducting investigations on the control of grain size of clay refractories and it is believed that this study, although incomplete, will probably lead to the greatest development that could be expected in clay refractories. On this general subject, therefore, four papers will be presented, first among which will be the contribution of M. C. Booze, vice-president of the Chas. Taylor Sons Co., Cincinnati, Ohio, who will speak on "Research in the Refractories Industry." "Properties of Clay Refractories Resulting from the Control of Grain Size of the Flint Clay, Refractories Fellowship, Mellon Institute; "Some Characteristics of Fire Clays and Brick Made From Them," by R. F. Geller, of the Bureau of Standards, Washington, D. C., and "The Effect of the Use of Purite Upon Refractories," by G. S. Evans, Mathison Alkali Works, Chicago, Ill., are the papers on the program to follow.

A new feature on the program is a questionnaire and discussion period to be devoted to such questions and problems in the field as will be brought to the attention of the meeting.

A buffet luncheon will be served on the day of the technical meeting, and in the evening there will be a dinner, to which special speakers have been invited. Reservations for this dinner should be made through the secretary, 2202 Oliver Building, Pittsburgh, Pa.

Florida Power and Canal Survey Makes Headway

Surveys now being made in connection with the proposed development of power at Lake Okefenokee are to be utilized by the board of Army engineers that is searching for the best route for a canal across Florida.

A recent report is to the effect that the examinations under the Federal Power Commission's preliminary permit are being undertaken in a thorough manner and will include considerable information needed by the Intercoastal Canal Board.

The Okefenokee project will convert a swamp into an attractive lake and will develop 40,000 hp. One of the proposed canal routes passes through the lake which will be created.

District Heating Men Plan Annual Meeting Program

The eighteenth annual convention of the National District Heating Association will be held this year at the West Baden Springs Hotel, West Baden, Ind., May 17 to 20, inclusive. Following the committee reports presented during the afternoon of May 17, an address on "Combined Electric and Heating Plants Operated as Heating Stations with Electricity as a By-Product," will be offered by C. W. Organ, general superintendent of the electrical department of the Illinois Power Co., and reports of the development committee and the manufacturers' division will be made in the evening.

On the program for the following day, among other business, will be an address by Prof. J. D. Hoffman, Purdue University, who will present "A Design for a New Underground Heating and Power Intercommunicating System for Purdue University," and the "Concentric Piping System of Steam Distribution" by J. E. Woodwell, consulting engineer of New York City.

The report of the heat utilization committee dealing with demand studies and that of the meter committee pertaining to demand meters will be followed by an address on "Pending Climatic Conditions" by Herbert Janvrin Browne, Washington, D. C.

The manufacturers' division will hold a session on the day preceding the opening of the convention. A full entertainment program has been arranged for those attending and visiting ladies. Reservations for rooms should be made directly with the West Baden Springs Hotel, West Baden, Ind.

Pennsy Abandons Community Power Plant

A plan sponsored by the Pennsylvania Railroad and announced at the personal direction of Gen. W. W. Atterbury, president of the railroad earlier this year, for a "community" power plant to serve utility and railroad companies centering in Philadelphia has been definitely abandoned.

This was made known April 6 by an eminent Philadelphia financial authority, who also stated that in the near future contracts will be negotiated with the Philadelphia Electric Co. by the railroad, the Reading Co. and the Baltimore & Ohio Railroad to supply these companies with electric power, these contracts to cover a term of years at service rates mutually satisfactory, but subject to approval of the Pennsylvania Public Service Commission.

Foshay Co. Sells Control in People's Light & Power

Controlling interest in the Peoples Light & Power Corp., which operates public utility properties valued at $26,000,000 in 15 states, has been purchased by G. L. Ohrstrum & Co. of New York from the W. B. Foshay Co., Minneapolis, according to a recent announcement by George L. Ohrstrum, head of the banking firm. The corporation and its subsidiary companies serve more than 150 communities throughout the country.

The W. B. Foshay Co. will continue its activities in the utility field, C. W. Salisbury, vice-president of the company, said regarding the sale, acquiring, operating and financing such properties as it can advantageously purchase. Several properties are already under contract to be taken over at an early date.

William Goodman, Developer of Diesel Engine, Dies

William Goodman, inventor and engineer and vice-president of the Worthington Pump & Machinery Corp., died April 21 following an operation at the Manhattan Eye, Ear, Nose and Throat Hospital in New York City. He was fifty-three years old.

Mr. Goodman had been in charge of manufacturing and engineering for the Worthington company and was known for his development of the new two-stroke-cycle double-acting Diesel engine, recently acquired by the United States Shipping Board, and the development of the feather-valve air compressor. His office was at 115 Broadway, New York City.

Born July 8, 1874, in Cincinnati, he was graduated from Haverford in 1895 and Harvard in 1896. He entered the engineering department of the Laidlaw-Gunn-Gordon Co., of Cincinnati, later absorbed by the Worthington unit. He became general manager of the Cincinnati plant and in 1918 was transferred to the New York office as assistant to the vice-president. He was elected a vice-president in 1922.

In the Spanish-American War he served as an ensign in the navy. In the World War he was in charge of the manufacture of munitions at the Worthington plant at Hazleton, Pa.

Mr. Goodman was a member of the American Society of Mechanical Engineers.

Purdue Wins Debate on Boulder Dam Project

Purdue university's team won a decision over a team representing Rose Polytechnic Institute recently in a debate at a meeting of the Indianapolis section of the American Society of Mechanical Engineers. The Purdue team argued the affirmative of the question, "Resolved, That the Boulder Dam Project Should Be Developed and Operated by the United States Government."

The affirmative made the need for flood prevention, its central argument with the development of power as a financial aid to the project. The negative admitted the need of flood prevention, but attempted to prove that the Boulder Canyon site was not the proper one to develop first, nor was it proper to develop it according to the present scheme.

The affirmative won the debate chiefly on their presentation and the manner in which they handled their arguments, rather than by the strength of their arguments.

Prof. Claude Sifritt of the public speaking department at Butler university, was judge. Members of the Purdue team were: Q. M. Crater of Franklin, L. L. Huxtable of New York and G. E. Willers of Lawrenceburg. The Rose Polytechnic team was composed of Raymond P. Morris, Morris T. Shattuck and Herman A. Moensch.

A.I.E.E. Students Will Hold Chicago Exposition

At Lewis Institute, Chicago, student branches of the American Institute of Electrical Engineers and the Western Society of Engineers will conduct an engineering exposition during May 18, 19 and 20, at which recent engineering developments will be featured.

Of special interest will be the Commonwealth Edison Co. display and lecture portraying the method of power generation and distribution in the city, and the Illinois Bell Telephone Co.'s manual and machine demonstration.

Bituminous Report on Sale

The proceedings of the International Conference on Bituminous Coal, reviewed in the April 19 issue of *Power*, are obtainable from the President's Office, Carnegie Institute of Technology, Pittsburgh, Pa., at $7.00 per copy.

Diesel Notes

The Federal Light & Traction Co. has purchased a 4,000-hp. Diesel engine-generator set from the Busch Sulzer Diesel Engine Co. for installation in its Tuscon, Ariz., power plant.

Ponca City, Okla., has let a contract to the Nordberg Manufacturing Co. for two 1,250-hp. Diesel engines for its municipal power and light plant.

Personal Mention

G. W. Bergen, formerly assistant plant equipment engineer with the Brooklyn Edison Co., is now chief engineer for the Robinson Butler Hemingway & Co.

Herbert Alfred Humphrey, mechanical and electrical engineer and member of the Royal Society, inventor of the Humphrey gas pump, arrived from England on the "Aquitania" April 20 to observe American practice and conditions.

Loughnan S. Pendred, editor of *The Engineer*, of London, arrived in this country April 21 for a visit of several weeks. He was tendered a luncheon at the Engineers Club, New York City, on the day of his coming. He plans to return to England May 28.

Col. H. C. Boyden, well-known lecturer on cement and concrete, has joined the staff of the Celite Products Co., manufacturer of a workability agent for use in concrete. A series of lectures will be given by Colonel Boyden in cities throughout the United States and Canada. His talks are being presented principally to engineering societies and associations, engineering colleges and also to general clubs and other organizations. He will be available for such talks through application to the Celite Products Co., 1320 South Hope St., Los Angeles.

Society Affairs

Association of Iron and Steel Electrical Engineers, Philadelphia Section, inspection trip to Edison Lighting Institute, Harrison, N. J., May 6.

American Water Works Association, New York Section, will hold its next meeting at Oswego, N. Y., May 5 and 6. E. D. Case, care of The Pitometer Co., 50 Church St., New York City, is secretary.

A.S.M.E., Akron, Ohio, at Akron University, April 29, 8 p.m., "Some Power Plant Misconceptions," by Prof. F. O. Ellenwood, Cornell University, Ithaca, N. Y.

A.S.M.E., Atlanta, Ga., May 9, discussions on "The Future Engineer, His Qualifications and Preparation." Many engineering obstacles and their solutions in the construction of the Eighth Avenue subway, New York City, will be treated through the presentation of a motion picture during the evening.

A.S.M.E., Philadelphia, Engineer's Club, 1317 Spruce St., April 26, 7 p.m., "Study on Surface Condensers in Steam Power Plants," by J. A. Powell and H. J. Vettlesen, both of the Barstow Management Association, Inc., of Reading, Pa.

A.S.M.E., Metropolitan, Engineering Societies Building, 33 West 39th St., New York City, April 27 at 8 p.m., National Defense Division joint meeting with the New York Sections of the A.S.C.E., A.I.E.E. and A.I.M.E. "The Manufacture of Springfield Rifles," by Col. R. McFarland, United States Military Academy, and "Ordnance—the Crux of Preparedness," by Col. James L. Walsh, vice-president, McGraw-Hill Publishing Company.

Business Notes

The Foote Bros. Gear & Machine Co. has assigned E. H. Sager, who recently joined the sales force of the company, to territory in the State of Michigan. He was formerly Chicago representative for the Ajax Flexible Coupling Co.

J. R. Shays, Jr., Inc., 100 Greenwich St., New York City, will handle from May 1 the sales in the entire Eastern district of the American High Speed Chain Company, of Indianapolis, Ind., manufacturer of silent and roller chains.

The Yeomans Brothers Co., 1433 Dayton St., Chicago, Ill., manufacturer of sewage ejectors and pumping machinery announces as new representatives, A. R. Amos, Jr.. 1014 Harrison Bldg., Philadelphia, Pa., and C. L. Knehr, 521 Hubbell Bldg., Des Moines, Iowa. These representatives will handle the complete Yeomans line which includes sewage ejectors, bilge pumps, house pumps and condensation return pumps.

The Fuller-Lehigh Co., Fullerton, Pa., following the taking over of the furnace wall, pulverized coal feeder and burner business of the Bailey Meter Co., has announced several appointments for its representation effective April 1. C. R. McClure, formerly manager of the New York office of the Bailey Meter Co., has been transferred to Fuller-Lehigh's New York office. W. R. Little is now with the Pittsburgh office of the company, W. E. East with that in Chicago, F. C. Brandt with the St. Louis office. G. C. Barnaby, 661 Folsom St., San Francisco, Calif., who represents the Bailey Meter Co. will also represent the Fuller-Lehigh Co.

Coming Conventions

American Association of Engineers. Annual convention, Tulsa, Okla., June 6-8; M. E. McIver, 63 East Adams St., Chicago.

American Boiler Manufacturers Association. Annual meeting at French Lick Springs Hotel, French Lick, Ind., May 30-June 1.

American Eletrochemical Society. Silver jubilee meeting at Philadelphia, Pa., April 27-30; H. E. Dalling, sec., Columbia University, New York.

American Institute of Electrical Engineers. F. L. Hutchinson, secretary, 33 West 39th St., New York City. Pittsfield, Mass., regional meeting May 25-27. Summer convention at Detroit, Mich., June 20-24 inclusive; Pacific Coast convention at Del Monte, Calif., Sept. 13-16.

American Order of Steam Engineers. Annual convention, Moose Hall, 1314 North Broad St., Philadelphia, Pa. June 13-16; J. E. Burke, 1821 So. Ringgold St., Philadelphia.

American Refractories Institute. Spring meeting at Hotel Traymore, Atlantic City, N. J., May 18-19; D. A. Texter, secretary, 2202 Oliver Bldg., Pittsburgh, Pa.

American Society of Civil Engineers. George T. Seabury, secretary. Annual convention at Denver, Col., July 13-15.

American Society of Mechanical Engineers. Spring meeting at White Sulphur Springs, W. Va., May 23-26. Calvin W. Rice, secretary.

American Society of Refrigerating Engineers. Western meeting at White Sulphur Springs, W. Va., May 23-25, in conjunction with the Spring meeting of the A.S.M.E.; W. H. Ross, 35 Warren St., N. Y.

American Society for Testing Materials. Annual convention at French Lick Springs Hotel, French Lick, Ind., June 20-24; J. K. Rittenhouse, secretary, 1315 Spruce St., Philadelphia, Pa.

American Water Works Association. W. M. Niesley, assistant secretary, 170 Broadway, N. Y. Annual convention Hotel Sherman, Chicago, June 6-11.

American Welding Society. Annual meeting at 29 West 39th St., New York City, April 27-28-29.

Association of Iron and Steel Electrical Engineers. Annual convention at Pittsburgh, Pa., June 13-18, inclusive.

National Association of Practical Refrigerating Engineers. Annual convention probably in November; E. H. Fox, 5707 W. Lake St., Chicago, Ill.

National Association of Stationary Engineers—Annual convention at Ambassador Hotel, Los Angeles, Calif., Aug. 22-27; John Topman, secretary, convention committee, Ohio State annual convention in Memorial Hall, Lima, Ohio, June 16-18; P. H. Grigsby, secretary, Lima, Ohio. New England States convention at Portland, Me., June 17-18; Thomas H. Clark, president, Worcester, Mass.; Robert Johnson, secretary, 65 Charlotte St., Worcester, Mass. Indiana State convention and power show at Anderson, May 27-28. Plainfield, N. J., meeting at Academy Hall, June 3-5.

National Board of Boiler and Pressure Vessel Inspectors. Annual meeting at Nashville, Tenn., June 8.

National District Heating Association. Annual convention at West Baden Springs Hotel, West Baden, Ind., May 17-20, inclusive; D. L. Saskill, secretary, Greenville, Ind.

National Electric Light Association. A. Jackson Marshall, secretary, 29 West 39th St., New York City. Convention at Atlantic City, June 6-10; exhibition, June 4-10.

Universal Craftsmen Council of Engineers. Thomas H. Jones, secretary, 33 Linden Ave., Cherrydale, Va. Annual convention at Buffalo, N. Y. Aug. 2-6.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous Net Tons	Market Quoting	April 18 1927
Pool 1	New York	$2.75@$3.00
Smokeless	Boston	1.61
Clearfield	Boston	1.65@ 2.00
Somerset	Boston	1.75@ 2.10
Kanawha	Columbus	1 40@ 1.75
Hocking	Columbus	1.60@ 1.75
Pittsburgh	Pittsburgh	2.25
Pittsburgh gas slack	Pittsburgh	1.60@ 1.75
Franklin, Ill.	Chicago	2 50@ 2.75
Central, Ill.	Chicago	2.25@ 2 50
Ind. 4th Vein	Chicago	2.40@ 2.50
West Ky.	Louisville	1 50@ 1.75
S. E. Ky.	Louisville	1.50@ 1.75
Big Seam	Birmingham	1 50@ 2.00
Anthracite Gross Tons		
Buckwheat No. 1.	New York	2 50@ 3 00
Buckwheat No. 1.	Philadelphia	2 50@ 3 00
Birdseye	New York	1.35@ 1.60

FUEL OIL

New York—April 21, light oil, tank-car lots; 28@34 deg. Baumé, 5¾c. per gal.; 36@40 deg., 6c. per gal. f.o.b. Bayonne, N. J.

St. Louis—April 12, tank-car lots, f.o.b. St. Louis; 24@26 deg., $1.90 per bbl.; 26@28 deg., $1.95 per bbl.; 28@30 deg., $2.00 per bbl.; 30@32 deg., $2.05 per bbl.; 32@36 deg., gas oil, 4.6c. per gal.; 38@40 deg., 5.7c. per gal.

Pittsburgh—April 18, f.o.b. local refinery; 30@34 deg., fuel oil, 6¼c. per gal.; 36@40 deg., fuel oil, 6.5c. per gal.

Philadelphia—April 14, 27@30 deg., $2.31@$2.37 per bbl.; 13@19 deg., $1.89 @$1.95 per bbl.

Cincinnati—April 19, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 6½c. per gal.; 26@30 deg., 6¾c. per gal.; 30@32 deg., 7c. per gal.

Chicago—April 18, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., $1.15 per bbl.; 26@30 deg., $1.20; 30@32 deg., $1.35.

Boston—April 18, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.45c. per gal.; 28@32 deg., 5.85c. per gal.

Dallas—April 16, f.o.b. local refinery, 26@30 deg., $1.45 per bbl.

The Power Specialty Co. has opened a new branch office to handle business in the Southern States in locating at 315 Bona Allen Bldg., Atlanta, Ga., an office that will serve the states of South Carolina, Georgia, Florida, Alabama and most of Tennessee. J. W. Lea has been placed in charge. Engineering estimates and advice will be furnished and drawings made for proposed installations in accordance with usual practice.

Trade Catalogs

Oil Engines—The Buckeye Machine Co., Lima, Ohio, is distributing an illustrated folder depicting installations of Buckeye engineers, 55 to 260 hp.

Spira-Flo Condensers—The Carbondale Machine Co., Carbondale, Pa., has issued Bulletin 226 on this type of condenser. Illustrations of sections and installations are given, with a dimensional table.

Spray Cooling Equipment — Power Plant Equipment Co., Kansas City, Mo., has issued a new 24-page catalog on spray ponds and spray cooling equipment, featuring the Marley spray nozzles, group tees and crosses and cluster grouping arrangements, with a page devoted to the Marley superheater for horizontal return-tubular boilers.

Motor Maintenance Equipment—The Martindale Electric Co., 1260 West 4th St., Cleveland, Ohio, is distributing Catalog No. 8 specially featuring commutator slotting and grinding equipment. This 36-page catalog contains 10 pages of new equipment added since the issue of catalog No. 7 and also contains a carbon brush maintenance and trouble chart on the center pages.

Tanks—The Adamson Manufacturing Co., East Palestine, Ohio, has issued Nos. 36 and 46 on welded tanks manufactured by the company. No. 36 describes tanks for underground storage and low-pressure systems, standard sizes running from 65 to 4,000 gal. capacity. No. 46 deals with tanks of large capacity for the storage of gasoline and oils, standard sizes running from 3,000 to 23,000 gal. Price list tables are given in each bulletin.

Sewage Pumps—The American Well Works, Aurora, Ill. Bulletin 193, just from the press, features a large number of sewage-pump installations designed to meet a wide variety of operating conditions. In the concluding pages details are given of the new American non-clogging pump of horizontal and vertical design, the vertical single-stage steel-frame pump made in any length of setting up to 100 ft. and single-stage horizontal, double-suction centrifugal pumps for strenuous service.

Atmospheric Drip Type Condensers—The Carbondale Machine Co., Carbondale, Pa., in Bulletin No. 125 described the Carbondale counterflow atmospheric drip type condenser, which is now being offered with further refinements in design and construction.

Centrifugal Sewage Ejectors—The Yeomans Brothers Co. has issued a new bulletin No. A-2300 describing Form "A" Ejector which is of the non-clogging type and operates without the use of any screen devices. This machine is of the dry pit type, having the sewage receiver in the center and the two centrifugal pumps on the outside, with suction connection to the bottom of receiver and discharge connection built together in a double branch fitting.

Grating and Treads—Arrowhead Iron Works, Inc., 427 West Fifth St., Kansas City, Mo. A handbook of 40 pages has been issued describing the different types of Arrowhead grating and treads, their various uses and specifications. To the company's standard line of products for floors, walkways, sidewalks, fire escapes and miscellaneous industrial uses, a rectangular grating and rectangular tread have been added. These are simplified designs of Arrowhead types to meet the requirements for inexpensive grating for walkways, sidewalk areas, treads, etc.

New Plant Construction

Calif., Los Angeles—Highbourne Holding Co., c/o C. R. Selkirk, California Bldg., Archt., awarded contract for the construction of a 6 story apartment on Highland Ave. to M. Smith, 6665 Sunset Blvd. Estimated cost $225,000. Steam heating and refrigeration systems, electric elevators, etc. will be installed.

Calif., Los Angeles—H. J. Tremain & Associates, Chicago, Ill., awarded contract for the construction of a 12 story hotel at 9th St. and Broadway to Edwards, Wildey & Dixon, Edwards & Wildey Bldg. Estimated cost $1,500,000.

Calif., San Diego—Mundy & Black & Associates, will soon receive bids for the construction of a 12 story office building including steam heating system, 5 elevators, etc. at B. and C. Sts. Estimated cost $1,000,000. L. A. Smith, Film Exchange Bldg., Los Angeles, is architect.

Conn., New Haven—Tidewater Oil Sales Corp., 11 Broadway, New York, N. Y., awarded contract for the construction of boiler house, etc. on Forbes Ave. here. to J. N. Leonard & Co., 902 Chapel St., New Haven, Conn. Estimated cost $60,000.

Ill., Evanston—E. L. Anderson, 30 North Clark St., Chicago, had plans prepared for the construction of an apartment building including electric refrigeration system, etc. at Oakton, Ridge and Elmwood Aves., here. Estimated cost $550,000. G. Larson, 5154 North Clark St., is architect.

Ill., Galesburg—City will receive bids about May 10 for waterworks improvements including pump house, etc. Estimated cost $125,000. Pearse, Greeley & Hansen, 6 North Michigan Ave., Chicago, Ill., are engineers.

Ill., Matteson—City will soon receive bids for the construction of a sewage disposal plant and pumping station at Indian Wood Golf Club. Estimated cost $25,000. Shields, Jordan & Roe, 8 South Dearborn St., Chicago, are engineers.

Ind., East Chicago—St. Catherine Hospital, c/o Sisters of Poor Hand Maids of Jesus, awarded contract for the construction of a 5 story hospital to H. B. Olney. Estimated cost $1,250,000.

Steam heating system, etc. will be installed.

Ia., Davenport—American Commercial & Savings Bank, 230 Main St., awarded contract for the construction of a 14 story bank and office building to Walsh Construction Co. Estimated cost $2,000,000.

Ia., Keokuk—Mississippi River Power Co., is having plans prepared for the construction of four additional units to power plant to increase the capacity 40,000 kw. Estimated cost $2,500,000.

Ia., Newton—City voted $155,000 bonds for waterworks improvements including new well, pump house, pumps, etc. Lafayette Higgins, 211 Continental Bldg., Des Moines, is engineer.

Ia., Oskaloosa — Des Moines Light Co., Des Moines, plans the construction of a switch house here. Estimated cost $125,000. Private plans.

Ia., Sheldon—City plans an election May 4 to vote $35,000 bonds for the construction of an electric light and power plant.

Mass., Somerset—City will soon award contract for the construction of a pumping station. Estimated cost $40,000. F. A. Barbour, Tremont Bldg., Boston, is engineer.

Mich., Detroit—Peninsular Stove Works, 1417 West Fort St., will soon award contract for the construction of a plant including boiler house, etc. on Burt Rd. A. Kahn, 1,000 Marquette Bldg., is architect.

Minn., Hibbing—Water, Light, Power and Building Comn., will soon award contract for the construction of addition to power plant. R. D. Thomas and A. P. McDonald, 1200 2nd Ave., Minneapolis, are engineers.

Miss., Leland—City plans an election May 2 to vote $50,000 bonds for extensions and improvements to light and power plant also installation of additional equipment. Swanson-McGraw Inc., Balter Bldg., New Orleans, is engineer.

Mo., Kansas City—Kansas City Power & Light Co., 14th St. and Grand Ave., has acquired the plant of the Kansas City Public Service Co., and plans to remodel same. Estimated cost $1,500,000. Private plans. Equipment will be required.

Mo., St. Louis — General Electric Co., River Rd., Schenectady, N. Y., plans the construction of an electric manufacturing plant at Bircher and Goodfellow Aves., here. Private plans.

Mo., St. Louis — Laclede Gas Light Co., 1017 Olive St. and Laclede Power & Light Co., plan extensions and improvements to electric light plant, and extension to distribution lines at Main and Mound Sts., including 12,500 kw. turbo-generator, boilers, coal and water handling equipment, transformers, switchboards, etc. Estimated cost $942,220.

Mo., St. Louis—Missouri Pacific R.R., Railway Exchange Bldg., is receiving new bids for the construction of a 22 story office building including power plant, boilers, generators, etc. at 13th, Pine and Olive Sts. Estimated cost $2,000,000. E. M. Tucker, c/o owner, and Mauran, Russell & Crowell, Chemical Bldg., are architects. E. A. Hadley, is chief engineer. Former bids rejected.

Mo., Stanberry—City voted $30,000 bonds for the construction of an electric light plant and distribution system.

Neb., Grand Island—City, H. E. Clifford, Clk. will soon award contract for the construction of addition to power plant including superheaters and complete equipment. Estimated cost $65,000. Pillsbury Engineering Co., 2344 Nicollet Ave., Minneapolis, Minn., is engineer.

N. H., Concord—Margaret Pillsbury General Hospital, awarded contract for the construciotn of addition to hospital, nurses' home, power house, etc. to L. Rochford & Son, 44 Front St., Worcester, Mass. Estimated cost $150,000.

N. J., East Orange—J. H. Mayzel, 70 Hidden Terrace, Newark, is having revised plans prepared for the construction of a 10 story apartment including steam heating system, boilers, elevators, etc. at 91 Washington St. here. Estimated cost $500,000. E. V. Warren, 31 Warren St., Newark, is architect.

N. J., Newark—Bordens Farm Products Co. Inc., 110 Hudson St., New York, N. Y. will receive bids until May 1 for the construction of a pasteurizing plant including steam heating and refrigeration systems, boilers, etc. at Orange and Nesbitt Sts. Estimated cost $1,000,000.

N. Y., Brooklyn—S. Silk, 41st St. and 5th Ave., will build a 9 story apartment at 52 Clark St. Estimated cost $1,000,000. Slee & Bryson, 160 Montague St., are architects. Owner is general contractor.

N. Y., New Rochelle—A. Robertshaw, 100 Pelham Rd., awarded contract for the construction of a 6 story apartment at Pelham Rd. and Oalahurst Gardens to Norris Construction Co., 67 West 44th St., New York. Estimated cost $500,000.

Steam heating system will be installed.

N. Y., New York—A. DePinna Co. Inc., L. S. DePinna, Pres., 626 5th Ave., is having plans prepared for the construction of a 10 story stores building including steam heating and ventilation systems, boilers, elevators, etc. at 52nd St. and 5th Ave. Estimated cost $1,000,000. Starrett & Van Vleck, 393 7th Ave., are architects.

N. Y., New York—Fred Realty Corp., 1359 Broadway, is having preliminary plans prepared for the construction of a 15 story apartment at 327 Central Park West. G. & E. Blum, 155 East 42nd St., are architects.

N. Y., New York—National City Bank, 55 Wall St., awarded contract for the construction of a 25 story bank and office building at 48-52 Wall St. to M. Eidlitz, 41 East 42nd St. Estimated cost $2,500,000.

Steam heating and ventilation systems, elevators, etc. will be installed.

N. J., Newark—New York Telephone Co., 140 West St., New York, N. Y., is having preliminary designs made for the construction of a 20 story exchange and office building including steam heating system, boilers, elevators, etc. at 540 Broad St. here. Estimated cost $3,000,000. McKenzie, Voorhess & Gmelin, 342 Madison Ave., New York, N. Y., are architects.

N. C., Durham—Five Points Building Co. Inc., plans the construction of a 16 story office building. Estimated cost $1,700,000. W. P. Budd, is interested.

N. D. Wahpeton—Otter Tail Power Co., Fergus Falls, Minn., awarded contract for the construction of a steam power plant here to Siems, Helmars & Shapfiar, 514 Guarantee Life Bldg., St. Paul, Minn. Estimated cost $490,600.

O., Cleveland—The Distributing Terminal & Cold Storage Co. c/o W. S. Bicknell, Keith Bldg., awarded contract for the construction of a cold storage plant at West 14th St. and University Rd. to Lundoff-Bicknell Co., Keith Bldg. Estimated cost $1,000,000. Refrigeration system, pumps, etc. will be installed.

Okla., Alva — Southwest Power Co. awarded contract for the construction of addition to power plant to H. Long. Estimated cost $48,000.

Okla., Oklahoma City—Oklahoma City Building & Loan Co., is having preliminary plans prepared for the construction of an 8 story office building including steam heating system, etc. on Harvey St. Estimated cost $500,000. Hank & Parr, Cotton Exchange Bldg., are architects.

Okla., Tulsa—C. W. Day, 502 South Boulder St., awarded contract for the construction of a 10 story office building on Boulder St. to Manhattan Construction Co., Muskogee. Estimated cost $800,000. Steam heating, ventilation and refrigeration systems, elevators, etc. will be installed.

Pa., Philadelphia—Mt. Sinai Hospital, J. S. Cohen, Jr., Fifth and Reed Sts., is having plans prepared for the construction of addition to hospital. Estimated cost $1,000,000. Magaziner, Eberhard & Harris, 603 Chestnut St., are architects.

Pa., Pittsburgh—Duquesne Light Co., 435 6th Ave., will build a switch house. Estimated cost $1,000,000. Private plans. Work will be done on separate contracts.

Tenn., Jackson — Southern Hotel Co. awarded contract for the construction of an 8 story hotel on Public Sq. to B. E. Buffaloe Construction Co., Memphis. Estimated cost $750,000. Steam heating, ventilation and refrigeration systems, boilers, pumps, elevators, etc., will be installed.

Tex., Big Springs—City plans improvements to waterworks and distribution system including pumping equipment, etc. Estimated cost $35,000. L. Martin, City Manager.

Tex., Brownwood — Brown County Improvement Dist., c/o J. R. Looney, plans the construction of a dam, 2,000 ft. long and 125 ft. high on the Pecan Bayou River, 9 mi. north of Brownwood to impound water for municipal, power and irrigation purposes, also a turbine plant. Estimated cost $1,500,000. Private plans.

Tex., Marfa—Central Power & Light Co., C. R. Norman, Mgr., Frost Bldg., San Antonio, plans to rebuild entire lighting system, also install new machinery here. Estimated cost $30,000. Private plans.

Tex., Moulton—E. and A. Kolar, Flatonia, has acquired the plant of the Moulton Cotton Oil Co. and is having surveys made for extensions and improvements including power plant, also installation of equipment, probably electrically-driven. Private plans.

Tex., San Antonio—San Antonio Athletic Club, is having plans prepared for the construction of a 20 story hotel, club and theatre building at Houston and Nacogdoches Sts. Estimated cost $1,500,000. L. Harrington & Co., Builders Exchange Bldg., are architects and engineers.

Tex., Weslaco—W. Burns and E. W. Napier, Harlingen, is having plans prepared for the construction of a cold storage plant here. Estimated cost $100,000.

N. S., Halifax—Nova Scotia Public Fish Cold Storage Terminals Ltd., plans the construction of a cold storage plant, 1,000,000 cu.ft. capacity. Estimated cost $2,250,000.

Equipment Wanted

Blowers, Motors, Etc.—Sanitary District, Decatur, Ill., will receive bids until May 5 for blowers, motors, switchboard, air meters, air filters, conduits, etc. for proposed blower house.

Compressor—Public Works Office, Navy Yard, Mare Island, Calif., will receive bids until Apr. 27 for a 6 ton ammonia compressor, single acting, automatic control with gauges, thermometers, electric motor, etc.

Conveyor—The Flontkote Co., P. O. Box 1122, New Orleans, La., is in the market for a 600 ft. trough belt conveyor, 14 to 20 in. wide complete with troughing rolls and return idlers, 3 or 4 sets of head-and-tail pulls, traveling automatic or hand-operated tripper, bucket elevator about 10 x 6 ft. buckets, 20 ft. high, Cochrane or Webster used open feed water heater with oil filter, 700 to 1,000 hp.

Electric Meters, Etc. — Banta-Cabrona Irrigation Dist., W. Scholssman, Secy., Tracy, Calif., will receive bids until May 11, for furnishing and installing electric meters; demand recording and watt hour measuring device with transformers, clock and recording device for 60,000 v. transmission line; recording volt meters for 2,200 v. transmission line at pump house 1 and 4 all accessories for connection and operation.

Ice Machines, Motors, Etc.—Electrical Engineers Ltd., Calgary, Alta., plans to purchase ten belted type ice machines and 75 to 100 hp. 2,200 v. 3 ph., 60 cycle, 720 r.p.m. synchronous motors.

Motor Generator Sets—Dept. of Public Works, Ottawa, Ont., is in the market for motor generator sets for Montreal. Estimated cost $11,000.

Motors—Empire Refinery Co., Ponca City, Okla., will be in the market for 60 new motors 5 to 150 hp. each for proposed extension to oil refinery. Estimated cost $1,000,000.

Motors—E. Vincent, 6269 De La Roche St., Montreal, Que., is in the market for two 15 hp. electric motors.

Pump—Bd. of Public Works, Wauwatosa, Wis., will receive bids until Apr. 29 for furnishing and installation 1,000 g.p.m. deep well turbine centrifugal pump.

Pump—City of Francis, Okla., will be in the market for a deep well pump for proposed waterworks improvements. Estimated cost $21,000.

Pump—Metropolitan District Water Supply Bd., 24 School St., Boston, Mass., will receive bids until Apr. 29 for furnishing and installing a 250 hp. motor driven centrifugal pump for proposed pumping station at Southboro.

Pumps—Dept. of Public Utilities, Richmond, Va., is in the market for two 75 and 40 hp. low lift pumps, 18 in. type 115 A, also two 125 and 50 hp. low lift pumps, 24 in. type 117 A.

Pumps, Etc.—Bd. of Trustees, Hamburg, N. Y., will receive bids until May 10, for pumps and filter equipment for proposed water filter plant and pumping station.

Pumps and Motors—City will be in the market for two deep well pumps and motors for proposed waterworks improvements. Estimated cost $60,000.

Pumping Equipment—Sewer Commissioners, H. E. Senft, Chn., Greenwich, Conn., will receive bids until May 5, for pumping equipment for proposed pumping stations, A, C, D, E, F and G, for Sewer Dist. 1, Sound Beach.

Turbines—City of Huntington, Ind., is in the market for turbines for electric light plant. Estimated cost $75,000.

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